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ABSTRACT

This report on student achievement in Illinois describes and synthesizes the results of six different measures of the achievement of Illinois students. The six tests are: (1) Illinois Inventory of Educational Progress, (2) Decade Study Test, (3) High School and Beyond Test, (4) Scholastic Aptitude Test, (5) American College Test, and (6) National Assessment of Educational Progress. These instruments are described in tabular form in terms of the students tested, curricular areas assessed, and overall purpose. This report provides an analysis of student progress across years, from basic to advanced skills in reading, language arts, social studies, mathematics, and science. An attempt has been made to integrate the results of the six measures of achievement to obtain a more complete picture of the performance of Illinois students and, indirectly, Illinois schools. This study of student achievement was conducted to answer three major questions: how well are Illinois students performing in academic areas as compared to students in other parts of the nation and the nation as a whole?; how well are Illinois students of today performing in academic areas as compared to Illinois students during the last decade?; and what student and school characteristics are related to achievement of Illinois students? (PN)

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STUDENT ACHIEVEMENT IN ILLINOIS:

An Analysis of Student Progress

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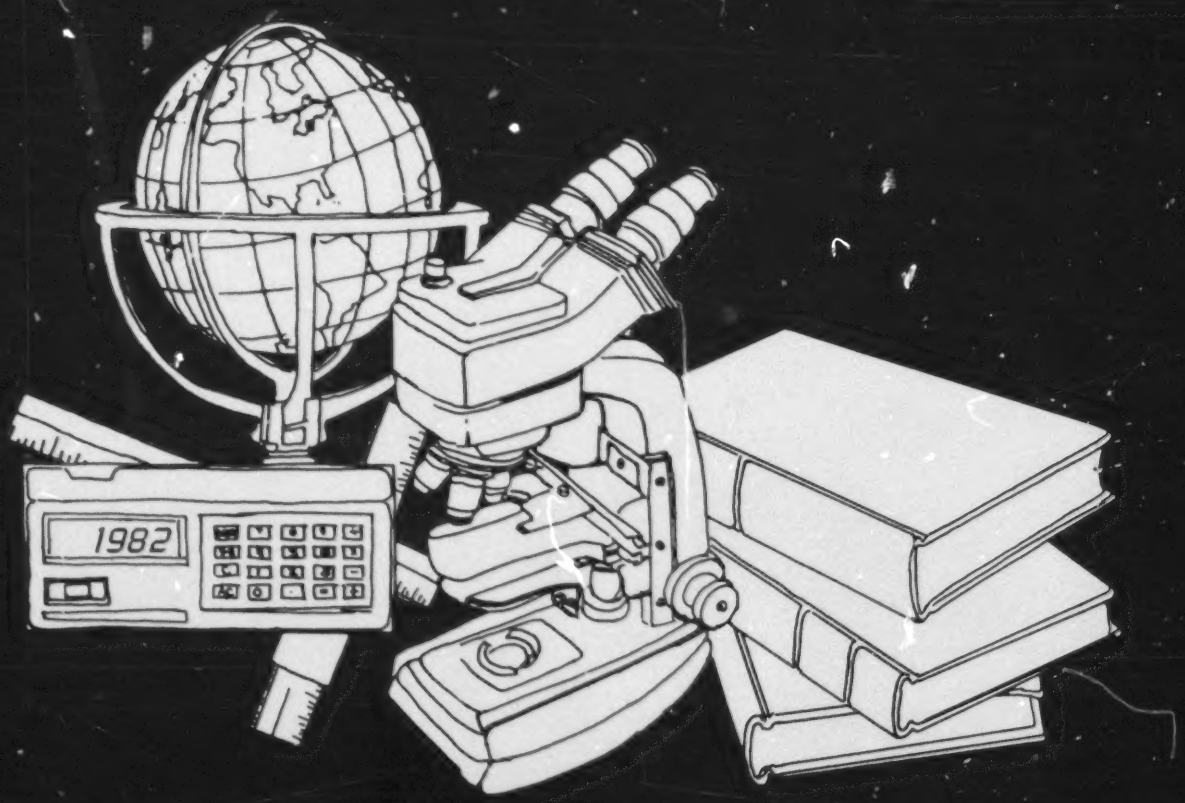

STUDENT ACHIEVEMENT IN ILLINOIS: AN ANALYSIS OF STUDENT PROGRESS

Illinois State Board of Education

November, 1982

FOREWORD

The Illinois State Board of Education is pleased to present this report on the achievement of students in Illinois. We hope it will stimulate readers to closely review the progress of students in their own districts. For further information about this document, you may contact Dr. Thomas Kerins, Manager of the Program Evaluation and Assessment Section.

Donald G. Gill
State Superintendent of Education

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STUDENT ACHIEVEMENT IN ILLINOIS: AN ANALYSIS OF STUDENT PROGRESS

Introduction and Summary of Findings

The following report on student achievement in Illinois has been prepared to give the State Board of Education and the citizens of the state a comprehensive picture of how Illinois students are performing in certain academic areas.

Over the past ten years, there has been a great deal of attention given to the decline of Scholastic Aptitude Test (SAT) scores among Illinois students and, correspondingly, to the one-point rise in these scores this year. While the general decline is significant and should not be ignored, it is inappropriate to judge the success or failure of the Illinois educational system on the basis of one test taken by only 15 percent of the state's high school graduating seniors.

In fact, the wisdom of using only SAT scores or any other single measures as reliable indicators of student achievement is increasingly coming into question among responsible persons who are interested in truly understanding the status of student learning. This perspective guided the State Board of Education's decision, in June of 1980, to adopt a student assessment policy which encouraged local school districts to develop comprehensive student testing and program evaluation plans based on multiple methods of student assessment. Similar actions requiring numerous measures of student progress as a basis for making educationally sound curriculum or policy decisions have been taking place throughout the country at both the state and local levels. Given this commitment to using multiple measures as the basis for evaluating and understanding student achievement, it seems appropriate that the project reported on the following pages and summarized here reflects those principles.

The report which follows describes and synthesizes the results of six different measures of the achievement of Illinois students; these six tests include the Illinois Inventory of Educational Progress (IIEP), Decade Study test (DST), High School and Beyond test (HSB), Scholastic Aptitude Test (SAT), American College Test (ACT), and National Assessment of Educational Progress (NAEP). Table 1 at the end of this summary describes these instruments in terms of the students tested, curricular areas assessed, and overall purpose. This summary and the accompanying technical report provide an analysis of student progress across years, from basic to advanced skills in reading, language arts, social studies, mathematics and science. To our knowledge, this is the first time that a state education agency has attempted to integrate the results of six different measures of achievement in order to obtain a more complete picture of the performance of its students and, indirectly, its schools.

This study of student achievement was conducted to answer three major questions:

1. How well are Illinois students performing in academic areas as compared to students in other parts of the nation and the nation as a whole?

2. How well are Illinois students of today performing in academic areas as compared to Ilinois students during the last decade?

3. What student and school characteristics are related to achievement of Illinois students?

Use of Test Information

There are certain limitations in the use of these test results. The tests are designed to measure student achievement and can not be used to assess the effectiveness of an individual district's educational program. Secondly, the tests are multiple-choice paper-and-pencil objective instruments which do not directly measure student knowledge. For example, students are not given a science problem and an appropriate set of materials to solve the problem. In the English test, students are required to edit mistakes rather than to actually write a paragraph. However, while other approaches provide a more direct assessment of a student's knowledge, the results in this report are valid and statistically significant. They constitute an accurate representation of the achievement of Illinois students.

Summary of Findings

- On the average, Illinois students are generally reading at the same level as their peers across the country. There are two sources of information regarding trends in student performance with advanced reading passages over the past ten years. The first source contains the IIEP and DST. The other source includes the ACT and SAT results. Results from the first source indicate that student performance drops significantly when the student responds to advanced and complex reading passages. However, data from the ACT and SAT indicate no significant drop since 1972 in the performance of Illinois college bound seniors on advanced verbal skills subtests.

- The ability of Illinois high school juniors to recognize correct English usage has declined significantly over the last ten years according to the DST.

- In social studies, Illinois students have performed well on questions about civil rights, government, economics, and sociology, but performance on test questions involving world cultures declined significantly between 1970 and 1981.

- Illinois students are solving mathematics problems on the average as well as their peers across the country and have been improving somewhat in basic computation and application. However, Illinois students have declined significantly in their ability to solve advanced mathematics problems according to the DST. In contrast results from the ACT and SAT show a stability of performance since 1972 of college bound seniors on complex and advanced mathematics subtests.

- In science, Illinois high school students are scoring on the average as well as their peers across the country, but there is a significant decline in Illinois performance over the past decade according to the DST. Overall achievement on the IIEP science tests from 1977 to 1981 was stable at the fourth grade level but declined significantly at the eighth and eleventh grade levels, particularly in life science.

- Achievement from one Illinois high school to another high school is much more varied than achievement from one elementary school to another.

- There is a strong positive relationship between the achievement of Illinois students and parent involvement in the education of their children -- the more parent involvement, the higher the student achievement.

- Illinois students identified as "test anxious" score significantly lower than students who are not test anxious.

- Differences in scores between black and white students in Illinois and in the nation are decreasing in mathematics and reading, but increasing in science.

- On the average, females in Illinois and the nation score below males in mathematics.

- The environment of a school influences student standards and values for achievement. The extent of the effect, according to backgound information from students taking the IIEP, varies from school to school indicating that some schools may exert a stronger press to achieve than other schools.

In general, Illinois students are scoring as well as other students across the country. However, the improvement on tests of basic and lower level skills is off-set by a decline on tests of more advanced skills.

The following sections summarize the results in reading, language arts, social studies, mathematics, and science. In addition, the effects of individual school and student characteristics on student achievement are discussed.

Subject Area Results

Reading

Data from the reading sections of the High School and Beyond test, ACT, and SAT indicate that Illinois students are performing at the same level as their counterparts in the Midwest and across the nation. Students are answering approximately half the questions correctly on all these tests.

Reading can be defined as the acquisition of knowledge from written prose and is not easily subdivided into specific skills. The minimal requirement for reading is "decoding," which includes simple recognition of letters, phonetic sounds, and syllables, as well as the use of prefixes and suffixes. Applying these skills to understanding and interpreting a reading passage requires the use of problem solving and other higher levels of functioning.

In two different national assessments of reading and literature in 1970-71 and 1979-80, NAEP reported that while students learn to read a wide range of materials, they develop few skills for examining the nature of the ideas that they take away from their reading at all grade levels. Students have difficulty in analyzing the text or defending their judgments and generally show little evidence of well-developed problem-solving strategies or critical-thinking skills.

A comparison of Illinois student performance from the past decade to the present indicates that the ability of students to read a passage and extract information either explicitly stated or inferred has declined since 1970. Although not based on answers to open-ended questions such as are included in the NAEP test, two sources of this information are the Illinois Inventory of Educational Progress (IIEP) and the Decade Study test.

IIEP reading results from grades four, eight, and eleven show stability for inferential comprehension--where the student has to go beyond the text for interpretation, and some decline for literal comprehension-- where the response is specifically stated in the reading passages. The largest decline in 1981 was for literal comprehension at the eleventh grade level. Results for all three grade levels indicate little or no change in performance in 1982 as compared to 1981 on the same or similar items. However, performance on more complex passages included in 1982 is lower than on the shorter assessment questions.

About one-third of the questions on the natural science and social science subtests of the Decade Study do not require previous knowledge of the subject matter to correctly answer the question. The questions are essentially reading items about science or social studies topics which students may answer by using only the information included in the passage. There was a significant decline in the natural science and social science total scores in 1981 as compared to 1970. The decline is partially attributable to the decline in reading skills. Results on individual items are not available for 1970, however, so it is not possible to compare performance on these individual reading comprehension items from 1970 to 1981.

Language Arts

Based on results of the Decade Study test, Illinois high school juniors are not able to correct errors dealing with proper verb tense, subject/verb agreement, adjective/adverb usage, pronoun usage, and prepositional phrases as well as juniors did eleven years ago. Although students were not asked to provide a writing sample in any of the tests, the knowledge of correct English usage is related to the ability to write. Students in 1981 scored significantly below their counterparts in 1970 on both English usage parts of the Decade Study test. The school mean score for Part I was 17.4 (out of 35) in 1970 and 15.3 in 1981. On Part II, the mean score fell from 16.6 (out of 30) correct in 1970 to 13.0 correct in 1981. The High School and Beyond test results show that Illinois students answered about 10 of the 17 editing and usage items correctly, which was similar to the average performance of students in the rest of the country. The High School and Beyond questions, however, require a lower level of skill or knowledge of English grammar than do questions in the Decade Study.

Social Studies

In social studies, Illinois students perform on the average as well as the national average. However, the performance of Illinois students today has declined as compared to student performance in the state eleven years ago.

ACT results (based upon students seeking admission to college) show that Illinois performance in social studies is essentially the same now as it was in 1972. But the Decade Study, which sampled a more diverse group of juniors (not just primarily the college-bound student) than did the ACT, resulted in scores that were lower in 1981 (39 percent correct) than in 1970 (44.4 percent correct).

IIEP scores for Illinois students, however, in contrast to NAEP and other national results, suggest that students do know about democratic government processes. In 1978, Illinois eleventh grade students answered an average of 80.2 percent of the social studies questions correctly. Topics included knowledge about Congress, obedience to law, and civil rights during criminal prosecution.

Mathematics

It appears that, on the average, Illinois high school students are achieving at the same level in mathematics as the national average. Also, Illinois students of 1981 are doing better in general mathematics but worse in advanced mathematics than Illinois students of the early and mid-1970s. In addition, the Decade Study results indicate that the more mathematics courses students took, the higher they scored on the mathematics section of the test.

The High School and Beyond study was used to compare Illinois with the rest of the nation in general mathematics. General mathematics is defined as student knowledge, computation and application through first semester algebra and geometry. General mathematics scores for Illinois sophomores and seniors were significantly higher than scores of sophomores and seniors in the South, but were not significantly different from scores in other regions of the nation or the nation as a whole. Sophomore mean scores show 49 percent correct responses for Illinois, 49 percent for the United States as a whole, and 44 percent for the South. Senior mean scores are 60 percent correct for Illinois, 60 percent correct nationally, and 54 percent correct for the South.

When comparing Illinois general mathematics scores for the years 1976 and 1981, students in 1981 did significantly better, according to data from the IIEP. The fourth grade mean score was 62 percent in 1981, compared to 55 percent in 1976; for the eighth grade the difference was 69 percent in 1981, compared to 60 percent in 1976; and for the eleventh grade, the score was 57 percent in 1981 and 50 percent in 1976. Preliminary analysis indicates that 1982 scores are also higher than 1976 scores at the fourth and eleventh grade levels and equivalent to the 1976 scores at the eighth grade level.

In advanced mathematics, defined as student knowledge, computation and application of advanced algebra, geometry, trigonometry and calculus, there are no significant differences between Illinois and national mean scores on the ACT. Based on a scale of 1 to 36, ACT scores in 1981 were 17.6 for Illinois and 17.3 for the United States on the average.

However, the Decade Study comparison of 1970 and 1981 Illinois juniors in the same schools shows significantly lower scores in advanced mathematics for the 1981 students. Scores averaged 35 percent in 1970 as compared to 32 percent in 1981. As part of the Decade Study, students reported the number of high school mathematics courses they had taken. As noted above, there was a significant positive correlation between the number of courses taken and scores on the Decade Study test, meaning the more mathematics they took, the higher they scored.

Science

Illinois students are achieving at about the same level in science as their peers across the country. Among three different grade levels (four, eight, and eleven) and three subtest areas (life sciences, physical sciences, and scientific methodology) assessed on the IIEP, there was an increase in only eleventh grade physical science scores from 1977 to 1981. The Decade Study results show a significant score decline over the last eleven years. The general science tests from NAEP show a significant decline in all regions of the country between 1970 and 1973 and again from 1973 to 1977.

On the science tests of the High School and Beyond study, Illinois high school sophomores scored significantly higher than sophomores in the South. Illinois scores were not significantly different from scores in any other geographical region. Scores on the test were 55 percent correct for Illinois, 50 percent for the South, and 55 percent for the United States as a whole.

College-bound high school seniors in Illinois and throughout the country are scoring essentially the same in 1981 as did college bound seniors in 1970 on the ACT natural science subtest. This subtest incorporates questions from physical and life sciences as well as scientific methodology.

The IIEP science tests were administered at the fourth, eighth, and eleventh grade levels in 1977 and 1981. Overall achievement on the IIEP science tests from 1977 to 1981 was stable at the fourth grade level, but declined significantly at the eighth and eleventh grade levels between these two time periods.

IIEP achievement in life science declined significantly at all grade levels between 1977 and 1981. Physical science achievement increased significantly at the eleventh grade level, but remained stable at the fourth and eighth grade levels. In knowledge and application of scientific methodology, fourth and eleventh graders performed equivalently both years, but eighth graders scored significantly lower in 1981 than in 1977.

Student performance in 1970 on the Decade Study test averaged 43 percent correct. In 1981, student performance declined significantly to 34 percent correct. The test includes questions about both physical and life sciences.

Student and School Characteristics

Certain student and school characteristics were also investigated in terms of their relationship to student performance and achievement. These variables were not studied for their causal impact on achievement. However, their relationship was investigated by statistically comparing the achievement associated with specific categories of these variables. An example of this would be the statistical comparison between the performance of students with more highly educated parents and students with parents with less education.

Differences in Student Achievement Levels among Elementary and High Schools

Data from the IIEP indicate that there is a greater difference in achievement levels among high schools than among elementary schools.

School Environment Effects

School environment does make a difference in how well students achieve, but the influence varies with student grade level. The IIEP was used to assess the values, standards, and expectations a student holds for achievement, as well as how the school could promote or inhibit these variables. The results show an influence at the elementary school level on student values and standards for achievement, but less of an influence on student expectation of achievement.

School Size

On mathematics sections of the IIEP test, fourth graders from small schools (below 500) scored the highest, while for the eighth and eleventh grades, the highest scores came from medium-sized schools (500-1,499). Science and reading results followed a somewhat similar pattern. The strongest performances for fourth and eighth grades were found in small schools, and the highest eleventh grade achievement was found for medium-sized schools.

The categories for the variable of school size were developed by Research Triangle Institute for the State Board of Education in 1975. These categories were small (below 500 students), medium (500 to 1,499 students), and large (1,500 or more students). This classification scheme may need to be revised as a reporting variable. It should be noted that other results relating school size to achievement can be found in a staff report on school organization presented to the Legislative Committee of the State Board of Education.

Parent Involvement

Students were asked on the IIEP to indicate how often they talk to their parents about their school work by marking responses ranging from "never or hardly at all" to "just about every day." Results show that involvement of parents in education is strongly related to a child's performance in school. For mathematics achievement, fourth and eleventh grade students indicating greater parental involvement scored as much as eight percentage points higher than students indicating little involvement by parents. The difference was about three percentage points at the eighth grade level.

Test Anxiety

Test anxiety can have a marked negative relationship to student achievement. The relationship was found to be highest for students enrolled in small or medium-sized schools, and for students with more highly educated parents. IIEP results indicate a strong and prevalent difference in performance of test-anxious versus non-anxious students at each grade level in mathematics, reading, and science. The degree of test anxiety was indicated by student responses on a seven-item scale.

Ethnic Differences in Achievement

NAEP results indicate a large gap between the performance of black and white students on achievment tests. However, more recent reports (1982) which compared achievement scores from 1970 through 1980 indicate that the gap may be narrowing in basic mathematics and literal reading skills.

Data on Illinois students tend to support the recent national data. Based on student performance measured by the IIEP, the mean scores of black students were compared with the mean scores of white students in mathematics, reading, and science. The difference in mathematics achievement scores of black and white students decreased at the eighth and eleventh grade levels from 1979 to 1981. For example, the difference between the black average score and the white average score in eighth grade dropped from 10.27 in 1979 to 8.16 in 1980 and 6.79 in 1981. At the same time, there was little change in the differences between the scores of black and white students at the fourth grade level.

The narrowing of the black/white differences also applied to reading scores, where the gap narrowed at the eighth grade level from 8.16 in 1979 to 6.37 in 1980 and 6.18 in 1981. For the fourth grade, the differences in reading scores decreased from 1979 to 1980--from 7.63 to 4.92--and remained stable in 1981. Scores for the eleventh grade show a significant decrease in the black/white differences from 15.81 in 1979 to 9.05 in 1980, but the difference increased slightly to 9.63 in 1981.

A reverse trend in the area of science is indicated by the results of science achievement tests. The average scores of black students and white students are almost one and one-half times as far apart in 1981 as they were in 1977 at the fourth and eleventh grade levels. The difference between the average scores of blacks and whites in the fourth grade jumped from 2.96 in 1977 to 4.53 in 1981, while the differences in the eleventh grade average scores increased from 4.77 to 9.47. In addition, there was a slight increase in the differences--from 6.10 in 1977 to 7.01 in 1981--among eighth graders. Thus, while the average scores of blacks and whites are growing increasingly closer on the IIEP in mathematics and reading, scores are becoming farther apart in science.

Recently released data from the College Board show stability in mathematics and reading scores on the SAT. The mathematics scores of black students were 4 points closer to those of white students in 1981 compared to 1976. Scores of black students on the verbal skills test were 7 points closer to scores of white students in 1981 than in 1976. It should be noted, however, that these results are not statistically significant.

Male/Female Differences in Achievement

IIEP results show statistically significant male/female differences in eleventh grade mathematics performance for 1981. Results from the SAT mathematics section show that males have consistently outscored females in Illinois and nationwide by 45 to 55 points each year.

In some cases, the disparity in scores between males and females translates into disparity in male/female participation in advanced programs or classes. For example, nearly twice as many males as females qualified for the Illinois Mathematics Talent Search, a gifted education program for the mathematically talented. A minimum score of 440 on the mathematics part of the SAT test is necessary to qualify. Of the fifth and sixth grade students scoring at least 440 in 1981, 65.6 percent were male and 34.4 percent were female.

The results from Illinois students who took the ACT show statistically significant sex differences in each of the four subtests. Male students scored significantly higher (average of 19.0) than female students (average of 16.4) on the mathematics subtest. On the natural science subtest, male students also performed significantly higher (average of 22.1) than female students (average of 19.6). The average performance of male students on the social studies subtest (18.4) was also significatly above the average of female students (16.8). Female students scored significantly above male students only on the ACT subtest of English. On the English subtest, female students averaged 18.3, whereas the average score of male students was 17.4.

TABLE 1.
Description of Tests

Test	Subtests	Grade Level	Sample	Purpose
Illinois Inventory of Educational Progress (IIEP) Assessment test administered by the Illinois State Board of Education	Reading Mathematics Science	4 8 11	Random sample of 2,400 students from 120 schools every year in one or more curricular areas since 1976	To assess the knowlege and skills of students on curricular bench marks: chart trends across years: identify factors which may affect student achievement
Decade Study A comparison between two administrations of a test which districts purchased from University of Illinois in 1970.	English (I & II) Mathematics (I & II) Natural Science Social Science	11	341 schools administered this test in 1970. 122 of these same schools were randomly selected to readminister the identical test in 1981.	To compare school performance using the same instrument over a 10-year period
High School and Beyond Part of a national survey on student attitudes, perceptions, and achievement which is administered by the National Opinion Research Center, University of Chicago.	Vocabulary Reading Mathematics (I & II) Science Civics Vocabulary (I & II) Reading	10 12	1,670 Illinois students 1,435 Illinois students	To measure the achievement and abilities of high school sophomores and seniors across the country. State sample was increased in order to make state generalizations.
Scholastic Aptitude Test (SAT) College admissions test	Verbal Quantitative	12	Self-selected college-bound sample of 23,500 Illinois students per year (15% of the total number of high school graduates)	To measure the developed verbal and quantitative reasoning abilities of college-bound students and aptitude for college level studies.

American College Test (ACT) College admissions test	English Mathematics Social Studies Natural Sciences	12	Self-selected college-bound sample of 101,500 Illinois students per year (66% of the total number of high school graduates)	Requirement for college admissions.
National Assessment of Educational Progress (NAEP) Test administered by the Educational Commission of the States used to study the achievement over time of students across the nation	Reading Mathematics Science	4 8 11	3,350 students per year	To assess the knowledge and skills of students in general subject areas across the country; to chart trends regionally and nationally. Data is not available for Illinois students.

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CHAPTER ONE

READING

Introduction

This chapter contains an analysis of the reading and language arts subtests of the Illinois Inventory of Educational Progress (IIEP), Decade Study, High School and Beyond, American College Test (ACT), and Scholastic Aptitude Test (SAT). The major results and discussion are included for each test along with sample items and a general summary.

One of the major problems in reviewing reading assessment results is the difficulty in defining the skills to be measured. Reading initially requires some skill in decoding. Decoding is the literal translation of the printed symbol and includes phonetic and structural analyses. Examples of phonetic exercises include recognition of letter names/sounds and vowel sounds. Structural knowledge includes the meaning and use of prefixes and suffixes and understanding syllables. "Reading comprehension" is a more inclusive term defined as the acquisition of knowledge (gaining meaning) from written prose. This process includes decoding skills, but also requires problem-solving techniques which are more difficult to identify and measure. Recent research on reading comprehension has centered on the interaction of what the child brings to the written page (world knowledge) and the meaning of what is actually written. This reading comprehension process must be used in all subject areas, regardless of content and structure. Subject knowledge cannot be learned without applying the problem-solving skills necessary to comprehend the written prose. Results on standardized tests indicate recent increases for primary grades (decoding skill emphasis) and decreases for intermediate and secondary grades (reading comprehension emphasis). One conclusion might be that decoding skills, but not comprehension, are being effectively taught.

Using results obtained on the five tests of verbal ability included in this report, it is possible to identify student strengths and weaknesses in comprehension of written prose, knowledge of vocabulary, and use of English grammar. The results provide information on achievement and progress over time in reading and language arts. In addition, Illinois student achievement and progress are compared to achievement in other states and the rest of the nation.

Illinois Inventory of Educational Progress

Grades four, eight, and eleven results from the 1979, 1980, and 1981 administrations of the IIEP reading test were analyzed in terms of the reading ability or skill--literal comprehension or inferential comprehension--required to answer each question.

> Literal comprehension is the ability to recognize or recall ideas, information, and happenings that are explicitly stated. It requires selection of a correct response on the basis of word analysis, word meaning, and/or syntactic relationship. Literal comprehension involves only one step: the reader sees the word and recognizes its meaning. Recognition of the meaning of difficult vocabulary is an example of literal comprehension.

Inferential comprehension is the ability to synthesize the literal content of a selection, using personal knowledge, intuition, and/or imagination as bases for conjecture or hypotheses. At least two steps are necessary when attempting to identify the appropriate implications of what is read: the reader must understand the literal meaning of the words and must also perceive that there are connotations, nuances, or implications beyond a literal interpretation. In reading passages, clues are provided to help the reader construct the necessary mediating symbol(s) for arrival at the appropriate conclusion.

The topical areas upon which the IIEP items are based are: sources of information, social studies, literature, and science. There were no significant differences in achievement results between or among the general topical areas on the IIEP tests.

The 1979 and 1980 tests are quite similar in content and item difficulty and included many of the same questions at all three grade levels. The 1981 test also included a number of questions on filling out job applications, reading a bus schedule, and the use of references. Eleventh grade students correctly answered over 80 percent of the items concerning job applications and bus schedules, but only 47 percent of the questions concerning the use of references. Eighth grade students correctly answered only 36 percent of the questions concerning the use of references. An example of a question concerning the use of references is:

In which reference would you look to find what territory was covered by Lewis and Clark on their exploration trip?

*A. Dictionary of American History
B. An Atlas
C. Historical Statistics of the United States
D. The World Almanac
E. A Thesaurus
F. Who's Who in America
G. Readers' Guide to Periodical Literature
H. Official State Government Handbook

The 1979 and 1980 tests contained many items of the short sentence cloze type requiring the student to fill in the missing word based on the context of the sentence or paragraph surrounding it. Student performance on this type of questions was usually above 80 percent. There were not as many cloze type questions on the 1981, as compared to 1979 and 1980, tests.

One cloze passage used with eleventh grade students for all three years is presented below along with the percentage of students answering correctly each year:

Looking at human societies we find two major kinds of economic systems. These two major divisions are the primitive economy and the modern economy.

14

In primitive societies people fulfill their needs mainly by hunting, gathering, and sometimes farming. Primitive people

1979 - 61%
1980 - 75%
1981 - 40%

change

a.	willingly
*b.	little
c.	rapidly
d.	unnaturally

over the centuries. They do most

1979 - 69%
1980 - 90%
1981 - 52%

things the same way their

a.	descendants
*b.	ancestors
c.	neighbors
d.	generation

did them a thousand years before. The life span of primitive people is relatively short. Their daily life is simple yet very demanding. The wife in a primitive economy often must make all household and personal articles, pots, clothing, and jewelry. The family shelter is made of animal skins or grass. Although some

1979 - 27%
1980 - 38%
1981 - 21%

a.	recreation
b.	economy
*c.	barter
d.	recovery

occurs in primitive societies, most people in the tribes still make almost everything they need if it is not

1979 - 63%
1980 - 85%
1981 - 45%

readily

a.	infeasible
b.	enacted
*c.	obtainable
d.	deduced

directly from the environment.

Mean percentages of correct responses for eleventh grade students on the above four items for 1979, 1980, and 1981 were 55, 72, and 40 percent, respectively. A similar trend exists for other groups of cloze items administered to eleventh grade students: scores rose modestly between 1979 and 1980 and then dropped dramatically in 1981.

Figures 1.1, 1.2, and 1.3 show the mean percentages of student correct responses on the reading items for both literal and inferential comprehension for grades four, eight, and eleven, respectively. Reading results for grades four, eight, and eleven show stability for inferential comprehension and some decline for literal comprehension in 1981 as compared to 1979 and 1980. The largest decline was found in literal comprehension at the eleventh grade level.

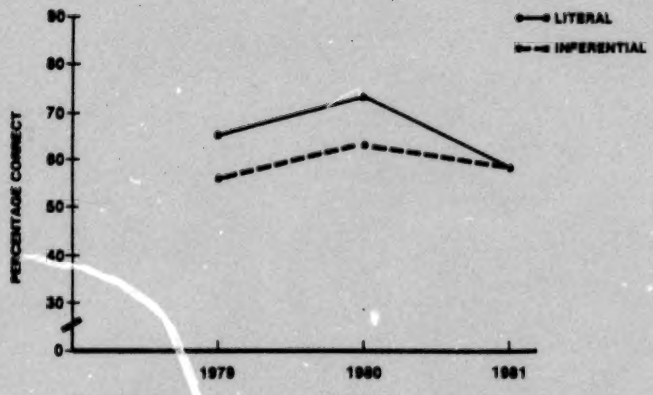

Figure 1.1.
Percentages of fourth grade reading items answered correctly by type of ability and year of administration.

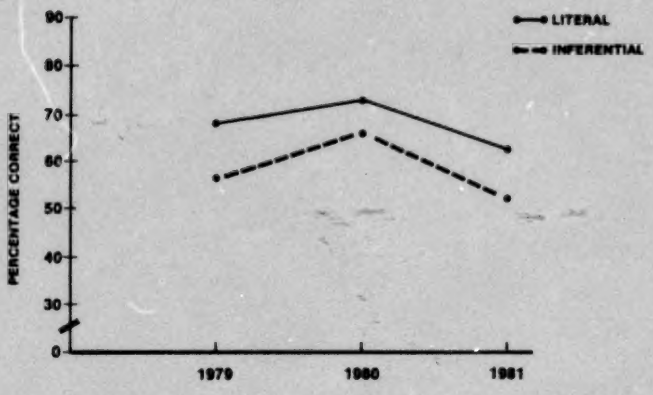

Figure 1.2.
Percentages of eighth grade reading items answered correctly by type of ability and year of administration.

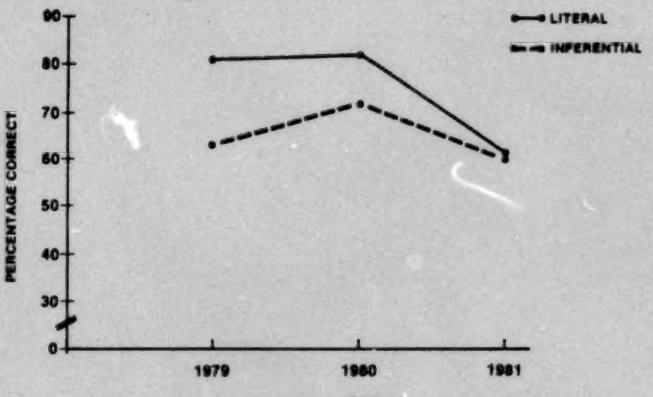

Figure 1.3.
Percentages of eleventh grade reading items answered correctly by type of ability and year of administration.

There was an increase in reading performance from 1979 to 1980. However, between 1980 and 1981, the mean percentages correct declined for all three grade levels and both ability areas. Declines ranged from 5 to 21 percentage points for each grade level between 1980 and 1981. The sharpest decline (21 percentage points) was for grade eleven literal comprehension between 1980 and 1981. The remaining declines between 1980 and 1981 ranged from 5 to 15 percentage points. With the exception of eleventh grade literal comprehension, the decline in performance in 1981 as compared to 1979 ranged from only 2 to 7 percentage points.

In addition to short-answer items which are the same as or similar to items on previous IIEP reading tests, the 1982 administration of the IIEP included longer passages as well as more comprehensive questions on the content. An attempt was made to include passages similar to those which students are required to read in the classroom. Longer passages appear to create more realistic memory demands than do short passages and allow students to use a greater amount of context in answering. In addition, these longer passages were based on either specific science or literature subject matter so that differences in subject-area performance could be identified.

Preliminary IIEP results for all three grade levels indicate little or no change in performance in 1982 as compared to 1981 on the same or similar items administered both years. However, performance on longer, more complex passages included for the first time in 1982 was somewhat lower than performance on the types of items administered in previous years. There appear to be no differences in reading performance in terms of the science and literature subject matter. Future administrations of the kinds of reading items included in the 1982 IIEP will provide information concerning the more comprehensive reading skills over time.

Decade Study Test

The Decade Study test was administered to grade eleven students in both 1970 and 1981. The test is similar to the ACT and SAT in difficulty, as well as format and type of questions. Although there is no specific part of the test which is labeled "reading," there are groups of items in both the social studies and natural sciences subtests which require the use of information given only in the text. In addition, there are two English usage parts which require students to correct errors in one or two short sentences. Table 1.1 shows Decade Study school means and standard deviations for each subtest by year of administration.

Table 1.1
Decade Study School Means and Standard Deviations

	1970		1981	
Subtest	Mean	S.D.	Mean	S.D.
English Usage Part I (35)*	17.4 (49.7)**	1.3	15.3 (43.7)	1.5
English Usage Part II (30)	16.6 (55.3)	1.2	13.0 (43.3)	1.3
Natural Sciences (23)	9.9 (43.0)	1.1	7.9 (34.3)	0.8
Social Studies (30)	13.3 (44.3)	1.4	11.7 (39.0)	1.2

*Number of items on each subtest is shown in parentheses.

**Percentages of items correct are shown in parentheses.

Table 1.1 shows lower mean scores on each of the subtests in 1981 as compared to 1970. The decrease is statistically significant for all subtests. There are no percentage correct data by item for 1970, so no comparisons at the item level are possible.

Reading items in natural science and social studies have been identified, and percentages correct in 1981 on these items were analyzed. The nine social studies reading items have a mean percentage correct of 47.7 percent. The mean percentage correct for the nine natural science items is 43.3 percent. This difference is not surprising due to the generally greater familiarity of vocabulary in social science as compared to natural science. As indicated previously, research supports the concept that what a child brings to the written page (world knowledge) interacts with what is in the prose resulting in "reading comprehension." Reading science or social studies materials might require knowledge of subject matter taught in specific courses, but some students have additional knowledge based on factors such as general abilities, use of vocabulary, and familiarity with current events.

Through factor analysis on the Decade Study test items, one factor which includes a majority of the reading items from social studies and natural sciences was identified and further supports the reading comprehension concept. It is difficult to judge the degree to which a question may be content-dependent for one student (i.e., the student must actually read and comprehend the test) and not content-dependent for another student (i.e., the student is able to answer questions without reading the passage). Students may be able to answer questions correctly by applying logic and other problem-solving skills. These processes enable them to eliminate obviously wrong choices, but do not necessarily result in an accurate measure of reading comprehension.

The two English usage subtests measure essentially the same knowledge about correct grammar, but with different formats. On the English Usage Part I subtest, students are required to read through a sentence and ascertain if there is an error in any of the underlined parts. The format in this section is as follows:

When (A) the results of a contest were finally (B)
made public, no one was more surprised or
thrilled (C) as Annette, who had written (D) the
winning essay. No error (E)

1981	Results
A	2.9%
B	7.5%
*C	21.3%
D	12.8%
E	54.0%

Table 1.1 shows that students in 1970 scored significantly higher on the 35 items of Part I in 1970 (17.4 items correct) than in 1981 (15.3 items correct). Most of the students who failed to correctly answer these types of questions responded "E" or "No error." None of the other response alternatives were chosen to any substantial degree. This finding might be the result of not recognizing the misuse based upon peer-accepted verbal communication containing grammatical errors. For items on which less than half the students responded correctly, several kinds of errors were identified. On many of the items, students seem to see the sentence in parts, as opposed to a whole. For example, on the following item most of the students did not detect the lack of parallel structure when "she escaped" was used:

Having been promised (A) asylum, Medea gave (B) free rein to (C) her passions, destroyed her enemies and she escaped. (D) No error (E)	1981	Results
	A	12%
	B	6%
	C	10%
	*D	42%
	E	30%

Other errors centered on the incorrect use of the past perfect tense and failure to distinguish between adjectives and adverbs. Many of these latter errors are heard in everyday speech ("good" used as an adverb; "easy" versus "easily"). Incorrect use of prepositions, prepositional phrases, and objects of prepositions, differences between "like" and "as," and inconsistency in pronoun usage were also common errors. Widespread failure to identify any error in the sentence resulted in 23 of the 35 items having means of less than 50 percent correct for 1981.

On the English Usage Part II subtest, students are required to demonstrate essentially the same knowledge about correct grammar as on Part I, but are required to correct the underlined section of each sentence:

> Being as how he had had the mumps already, Tim believed he was immune to that disease.

		1981 Results
(A)	Being as how he had had the mumps already, Tim	4.8%
(B)	Seeing as how he had already had the mumps, Tim	16.5%
*(C)	Having already had the mumps, Tim	58.7%
(D)	Having the mumps already, Tim	13.7%
(E)	He had already had the mumps, and Tim	5.6%

Although there were similar errors on both Decade Study English usage subtests, scores on Part II declined more sharply (from a mean of 16.6 items correct in 1970 to 13.0 in 1981) than did scores on Part I. In 1981, students did not as often respond "A" on Part II which is the equivalent of "No error" on Part I. Common difficulties encountered in 1981 by students on Part II involved non-parallel structure, misuse of superlatives, lack of pronoun-verb agreement, use of dangling modifiers, and failure to recognize "hardly" as a negative.

Through factor analysis, three factors were identified. Two of the factors were exclusively all English Part I or Part II. The third factor included items from both parts in which all correct answers are "No error." Although the format is slightly different, the two English usage subtests measure similar material. The level of student performance in English usage has dropped significantly over the past eleven years.

High School and Beyond

The High School and Beyond test was administered to grades ten and twelve students across the nation in the spring of 1980. The tests contain vocabulary and reading subtests. In addition, the sophomore test has science and civics subtests containing items which are identified as reading items and a writing subtest which contains language arts questions. Subtest results are presented in Tables 1.2 and 1.3.

Table 1.2
Mean Test Scores for Sophomore Students
in Public Schools - Spring 1980[a]

Geographical Region	Vocabulary (21)[b]	Reading (19)	Science (20)	Writing (17)	Civics (10)
Illinois	10.8(51.4)[c]	9.0(47.4)	11.1(55.5)	10.2(60.0)	5.9(59.0)
Other North Central	11.1(52.9)	9.4(49.5)	11.6(56.5)	10.7(62.9)*[d]	6.0(60.0)
New York	11.4(54.3)	9.4(49.5)	11.3(56.5)	10.3(60.6)	6.0(60.0)
Other North East	11.5(54.8)	9.2(48.4)	11.0(55.0)	10.3(60.6)	6.0(60.0)
South	9.6(45.7)*	8.2(43.2)*	10.0(50.0)*	9.5(55.9)*	5.5(55.0)*
West	11.5(54.8)*	9.4(49.5)	11.3(56.5)	10.7(62.9)	5.8(58.0)
Total United States	10.7(51.0)	9.0(47.4)	10.9(54.5)	10.2(60.0)	5.8(58.0)

[a]All means are weighted to better reflect the population values because of the two-stage stratified sampling design used.

[b]Numbers in parentheses indicate number of items per subtest.

[c]Numbers in parentheses indicate percentages of items correct.

[d]Asterisks indicate scores significantly different at the .01 level than scores for Illinois students.

Table 1.3
High School and Beyond
Mean Test Scores for Senior Students
in Public Schools - Spring 1980[a]

Geographical Region	Vocabulary (27)[b]	Reading (20)
Illinois	13.1(48.5)[c]	10.9(54.5)
Other North Central	13.2(48.9)	11.2(56.0)
New York	14.1(52.2)*[d]	11.7(58.5)*
Other North East	13.9(51.5)*	11.2(56.0)
South	11.6(43.0)*	10.0(50.0)*
West	13.4(49.6)	11.1(55.5)
Total United States	12.9(47.8)	10.8(54.0)

[a]All means are weighted to better reflect the population values because of the two-stage stratified sampling design used.

[b]Numbers in parentheses indicate number of items per subtest.

[c]Numbers in parentheses indicate percentages of items correct.

[d]Asterisks indicate scores significantly different at the .01 level than scores for Illinois students.

Table 1.2 shows that performance of Illinois sophomores was significantly lower than performance of Western states sophomores in vocabulary and of Western and other North Central states sophomores in writing. Sophomores in the South scored significantly lower than did Illinois sophomores on all subtests.

Table 1.3 shows that on each of the senior vocabulary and reading subtests, New York students answered about one more question correctly than did Illinois students. Illinois seniors scored approximately the same number correct as did students throughout the country except for the South where the scores were significantly lower. Most students in all groups answered only about 50 percent of the items correctly.

The High School and Beyond test is the only test being discussed in this report that contains a separate vocabulary section. Performance on the vocabulary items correlates with reading performance and general intelligence but does not necessarily reflect school outcomes (specific subject area instruction). The vocabulary items clustered around one factor on both the sophomore and senior subtests.

The reading passages on the High School and Beyond test are typical for standardized achievement tests. There are no data available to test the content dependency (whether a student could answer the question without actually reading and/or comprehending the prose) of the passages. There were no significant differences in results between reading questions on science or civics topics on either the sophomore or senior subtests. An example of a reading passage which was used on both the sophomore and senior test is given below with the percentages of students at each grade level answering correctly.

One theory of the effect of sunspots is that they have great influence on the earth. This theory suggests that "spots" on the sun consist of great whirling, fiery storms. In years when there are many sunspots, we have electric changes on our planet. There is much radio interference, and compasses on ships and planes do not point true. We have especially fine displays of northern lights. It is even believed that, in heavy sunspot years, people are more active and have shorter tempers. But perhaps most important, heavy sunspot years are years of long droughts.

The author is most concerned with	Sophomores	Seniors
A) describing sunspots		
*B) describing the effects that sun storms have on the earth	63%	72%
C) describing ways in which sun storms can be used by man		
D) explaining how sun storms cause storms on earth		
E) explaining how the effects of sun storms can be reduced		

It can be inferred from the passage that storms occurring on the sun have the LEAST direct influence on which of the following?

A) Human behavior		
B) Agriculture		
C) Communication		
D) Transportation		
*E) Industrialization	32%	45%

The author feels that the most important effect of sun storms is their effect on

A) radios		
B) ships' compasses		
*C) weather	43%	52%
D) the northern lights		
E) the behavior of people		

The way that the passage describes the storms on the sun (lines 2-4) suggests which of the following disturbances on the earth?

*A) Tornadoes	27%	41%
B) Blizzards		
C) Earthquakes		
D) Rainstorms		
E) Droughts		

One passage on the senior test which appears to be particularly difficul for students to comprehend is a literary narrative containing conversation and allegorical references. This is an example of the kind of writing students would encounter in high school literature courses. Seniors did very poorly in responding to the four questions about the passage.

Once upon a time the devil stayed at an inn where no one knew him, for they were people whose education had been neglected. He was bent on mischief and caused the inexperienced people much trouble. But at last the inkeeper set a watch upon the devil and took him in the fact.

The inkeeper got a piece of rope.

"Now I am going to thrash you," said the innkeeper.

"You have no right to be angry with me," said the devil. "I am only the devil, and it is my nature to do wrong."

"Is that so?" asked the innkeeper.

"It is a fact, I assure you," said the devil.

"You really cannot help doing ill?" asked the innkeeper.

"Not in the smallest," said the devil; "it would be useless cruelty to thrash a thing like me."

"It would indeed," said the innkeeper.

And he made a noose and hanged the devil.

14. According to the passage, the people at the inn suffered annoyance because they were

A)	bad by nature	
B)	damned by the devil	
C)	incapable of action	
*D)	unsophisticated	26%
E)	unwilling to learn	

15. As "fact" is used in line 6, it is a synonym for

A)	a sure thing	
B)	circumstance	
*C)	deed	17%
D)	discovery	
E)	proper idea	

16. The devil assumes that punishment is given to

*A)	bring about reform	47%
B)	even the score with society	
C)	gain revenge	
D)	serve as an example to others	
E)	follow a legal tradition	

The innkeeper's action is basically

A) forgiving
*B) logical 32%
C) self-contradictory
D) sentimental
E) impulsive

On the reading and vocabulary subtests of the High School and Beyond study, students answered about 50 percent of the items correctly at both the sophomore and senior levels. Percentages correct were similar to ACT and SAT percentages and somewhat higher than the scores on the Decade Study test.

The writing section on the sophomore test is misleading in its identification of content. Five of the 17 items include questions on punctuation. Students are asked to identify the error, but "no error" is not a choice, thus removing a strong distractor and making the questions less difficult than those on the Decade Study test. Most of the other questions require the student to identify correct formal English as opposed to obvious slang statements. There are also questions concerning an employment form and correct business letter format, reflecting somewhat the content of minimum competency tests. The average number correct for the 17 items is only slightly over 10 for Illinois and the rest of the country.

American College Test and Scholastic Aptitude Test

Figures 1.4 and 1.5 show that ACT scores in English and SAT scores in verbal ability for students in both Illinois and the rest of the nation have not declined significantly since 1972. The scores have remained on a plateau since 1972 for both males and females.

Students are answering approximately half of the items correctly on both of these national tests for college-bound students. Although none of the changes are statistically significant, female verbal scores on the SAT in Illinois and across the nation have declined more than have scores for male students. This same trend also occurs on the ACT English subtest, more dramatically in Illinois than at the national level. Further research is needed to explore this trend to determine its relationship to curriculum changes, nonverbal scores, and additional information from other data sources.

Discussion

Reading comprehension is not necessarily an identifiable domain in the same sense as mathematics. It is difficult to distinguish between previous knowledge (including natural abilities) and subject-matter learning. All of the previously mentioned tests of reading and verbal ability reflect both types of knowledge. Illinois students are not performing significantly differently than students in other states. The question remaining is how to use information concerning particular gains and losses to improve instruction. One area which is certainly related to the increased concern about writing ability is the area of English usage measured by the Decade Study test. Frequent hearing of incorrect usage can affect writing.

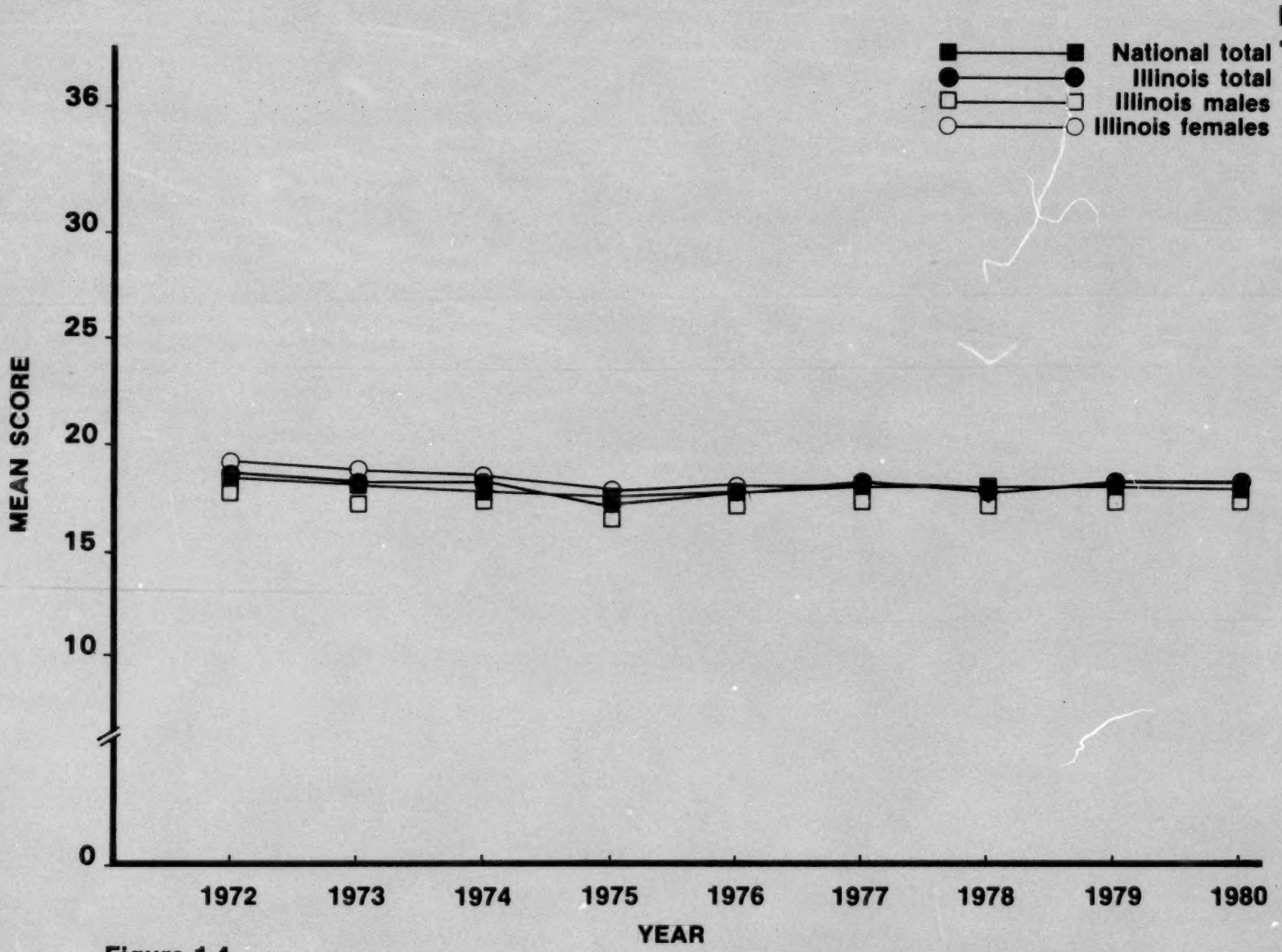

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Figure 1.4.
ACT mean scores in English by year.

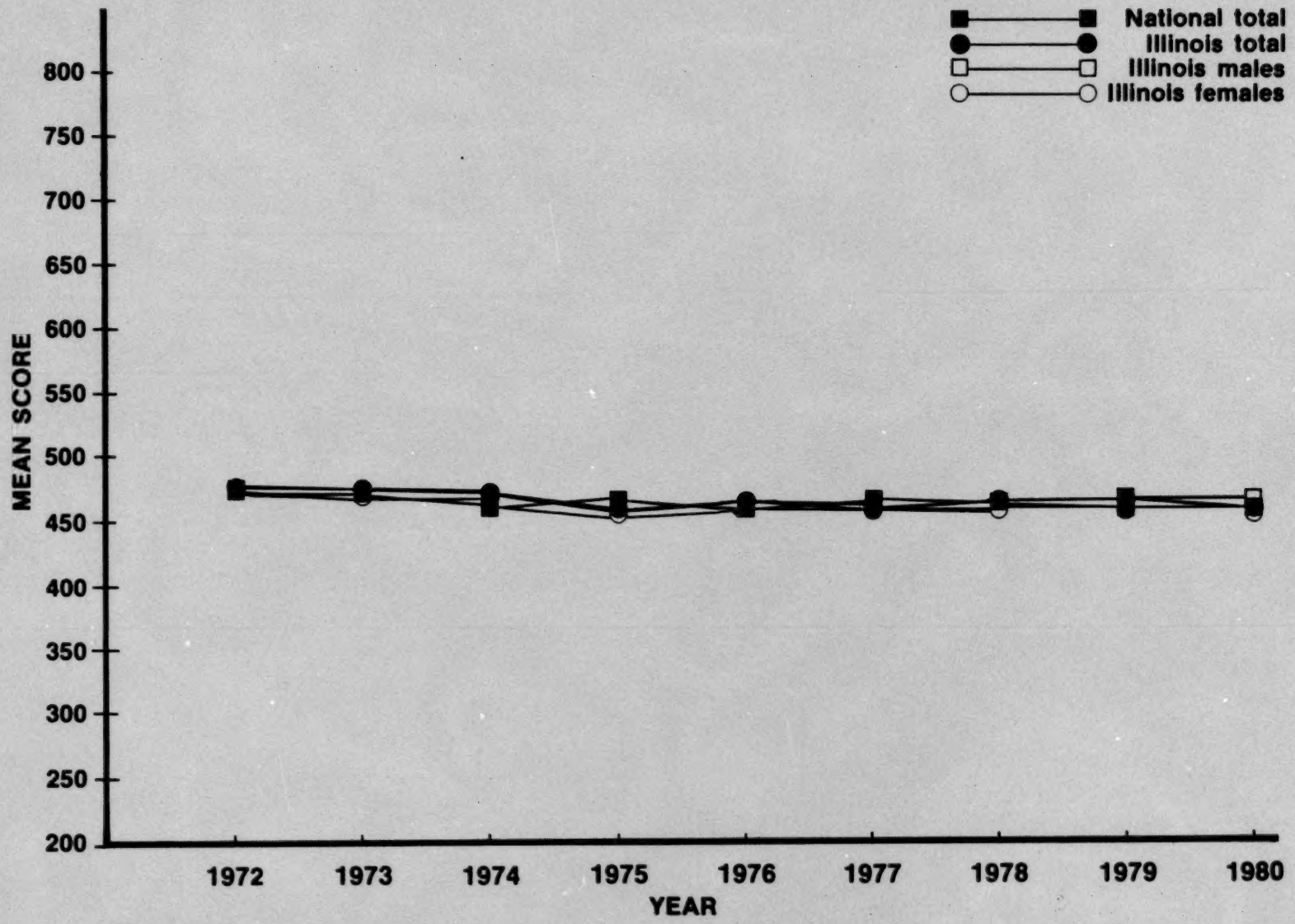

Figure 1.5.
SAT mean verbal scores by year.

However, the more students read and see correct usage, regardless of literary content, the more likely students will be able to identify usage errors, regardless of the fact that they are consistently hearing incorrect English. Further information on the types of English instruction and the content of textbooks is necessary before valid generalizations can be made.

It is important to ascertain the English requirement in each school, when and if English grammar is specifically taught, and the time lapse between test administration and the most recent English grammar instruction. Although there are 1977 Illinois State Board of Education Census of Secondary School Course Offerings data on the numbers and percentages of students enrolled in various English courses, there are no data on actual course content. The name of the course might not adequately reflect actual content. Grammar might be considered an important curricular subject, but might be reviewed and taught after the first semester of the junior year (following administration of the test). Many Illinois high schools have semester courses of English (English literature, business English, American literature, etc.). It also can be argued that these topics should have been taught before the eleventh grade. Regardless of the reason, Illinois students are not doing as well as they did eleven years ago in English usage.

In terms of overall reading skills, students respond correctly to the simple tasks involving decoding, but not to the higher level task of gaining meaning from the written page. In the related area of language arts, students in Illinois are not able to edit correct English usage as well as their counterparts did eleven years ago. Specific information will be obtained during the 1983 administration of the IIEP, which will include actual writing samples for grades four, eight, and eleven.

CHAPTER TWO

SOCIAL STUDIES

Introduction

Two of the tests being reviewed in this report, the American College Test (ACT) and the Decade Study test, have general sections labeled "social studies." There are also social studies types of materials which can be labeled as "civics" included in the High School and Beyond and the Illinois Inventory of Educational Progress tests. In addition, the Decade Study test contains a set of social studies items that can be separated from the general social studies items and considered part of civics.

Generally the tests contain two types of items. On the knowledge-type items, the student is asked to recall specific information. All of the tests include knowledge items. On the reading-type items, the student is asked to directly identify information in a short reading selection as an answer to a question, or to enter an answer based on what was presented. Only the ACT and the Decade Study tests include reading items. Sample knowledge- and reading-type items are presented below.

Knowledge Item

The main purpose of the Bill of Rights is to

A. prevent presidents from telling states what to do.
B. enlarge the scope of the powers of the federal government.
C. lessen the power of the Supreme Court to declare acts of Congress unconstitutional.
*D. limit the power of the federal government to abuse individual freedom.

Reading Items

Certain similarities between the civilizations of ancient Peruvian Indians and the civilizations of the inhabitants of some Pacific islands led Thor Heyerdahl to believe that possibly in the past the Peruvians had migrated across the Pacific and established homes on the islands. Peruvian Indian relics depicting large rafts of balsa wood indicate the manner in which this migration might have taken place. In order to see whether the journey was possible in such a vessel, Heyerdahl had a raft constructed of balsa logs and rope, reproducing as nearly as possible the original construction used by the Indians. The raft was equipped with a generous supply of canned and fresh food and water. A short-wave radio was also included. With a crew of six men, the raft set out from Peru in April 1947, and began to drift away in the Humboldt Current. The raft was wrecked on an uninhabited island far out in the Pacific 101 days later, and the crew made their way to shore safely. A week later they were found by Polynesians who arrived in canoes from a nearby island.

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The raft was constructed of balsa logs and rope because

A. Peru is an underdeveloped country with few resources.
*B. it was necessary to show that Indians could have made the trip.
C. the native workers were not familiar with advanced designs.
D. more rugged materials were not available at the time.

What effect did the carrying of a short-wave radio have on the validity of the experiment?

F. It tended to increase the validity, because the added weight made the trip more hazardous.
G. It tended to invalidate the experiment, because it made the crew feel safer.
H. It tended to invalidate the experiment, because the ancient Indians could not have had radios.
*J. It had no effect on the validity of the experiment.

Illinois Inventory of Educational Progress

In 1978 the Illinois Inventory of Educational Progress included a section dealing with "citizenship." Two of the areas assessed on the eleventh grade test were knowledge of the: (1) liberties and rights of all individuals and (2) main structure and functions of government.

The thirteen IIEP items assessing performance in these two areas require recall of factual knowledge. The average performance of Illinois juniors in 1978 on these items was 67.7 percent. Student performance on the four items concerning the federal level of government was 45.1 percent. The average score on the five items concerning legislative characteristics of government was 61.6 percent. The average score on the items dealing with the judicial branch of government was 55.9 percent. The average score on a group of four items dealing with general topics--voting, the Constitution, and the role of government--was 81.1 percent.

Decade Study Test

According to Educational Testing Service, the Decade Study test includes such subject areas as government, world history, United States history, economics, sociology, geography, and general culture. Table 2.1 shows Decade Study school means and standard deviations for social studies by year of administration.

Table 2.1
Decade Study School Means and Standard Deviations

	1970		1981	
Test	Mean	S.D.	Mean	S.D.
Social Studies (30)*	13.3 (44.3)**	1.4	11.7 (39.0)	1.2

*Number of items on the test is shown in parentheses.

**Percentages of items correct are shown in parentheses.

The average performance, using schools as the basis of analysis, was 44.3 percent in 1970 and 39 percent in 1982--a statistically significant difference.

About one-third of the test (9 items) relies heavily on reading skills. Twenty additional items test student knowledge. On the reading-type items, students scored an average of 47.7 percent. On the social studies knowledge items, the average score was 35.4 percent. Performance in terms of specific content areas averaged 24.1 percent for world history, 40.1 percent for government, 41.5 percent for economics, 47 percent for sociology, and 33 percent for general culture.

Eight items within the social studies subtest of the Decade Study were identified by the test authors as relating to government. Although the eight items did not all relate specifically to United States government, the principles examined are generic enough to be relevant to "government" in the United States. For example, based on a paragraph about Swiss Cantons, questions were posed about the concept of "referendum." Referendum is a concept relevant to the United States. Also in another set of questions, the concepts of "left," "right," "radical," and "conservative" were of interest. While the questions also included the terms "monarchist" and "socialists," a general awareness of the United States political spectrum could be of use in answering the questions.

On the eight civics items as a whole, Illinois juniors scored an average of 42.6 percent correct. On the reading-type items, students scored 51.4 percent. On the knowledge-type items, students scored 37.3 percent correct.

High School and Beyond

The sophomore civics section of the High School and Beyond test consists of 10 items. Six of the ten items can be answered either directly or through inference from reading material included with the items on the test. Answers to the remaining four items are based on prior subject-matter knowledge. The test calls for students to read and interpret pie charts; to apply such terms as "judicial review," "checks and balances," "majority rule," and "due process" to appropriate examples; to select appropriate questions to apply to given situations; and to recognize principles inferred from reading.

High School and Beyond results on the ten-item civics section are presented in Table 2.2.

Table 2.2
High School and Beyond
Mean Test Scores for Sophomore Students
in Public Schools - Spring 1980[a]

	Illinois	Other North Central	New York	Other North East	South	West	Total United States
Mean Number Correct	5.9	6.0	6.0	6.0	5.5*[b]	5.8	5.8
Mean Percentage Correct	59%	60%	60%	60%	55%	58%	58%

[a]All means are weighted to better reflect the population values because of the two-stage stratified sampling design used.

[b]The asterisk indicates score significantly different at the .01 level than score for Illinois students.

Illinois scores were not significantly different from scores for the other geographical regions except the South. Scores on the civics test were 59 percent for Illinois, 58 percent for the nation as a whole, and 55 percent for the South.

On the reading-type items, Illinois students scored 61.5 percent. On the knowledge items, students scored 54.2 percent.

American College Test

As described in the 1975 version of the American College Testing Program Technical Report, the ACT social studies test was designed to "measure evaluative reasoning, reading, and problem-solving skills required in social studies." (p.8) The ACT social studies test contains about 30 percent knowledge items and 70 percent reading items. The content of the ACT test includes European, ancient, and American history, as well as sociology, American government, economics, and contemporary social issues.

ACT social studies results for years 1972 to 1980, the most recent year for which results are available, are presented in Figure 2.1. According to Figure 2.1, Illinois students scored approximately at the national mean (Illinois, 17.3; United States, 17.2) in 1980. From 1972 to 1976, ACT social studies scores dropped in both Illinois and the nation as a whole. Illinois mean scores were 19.2 in 1972 and 17.0 in 1976. However, the difference is not statistically significant.

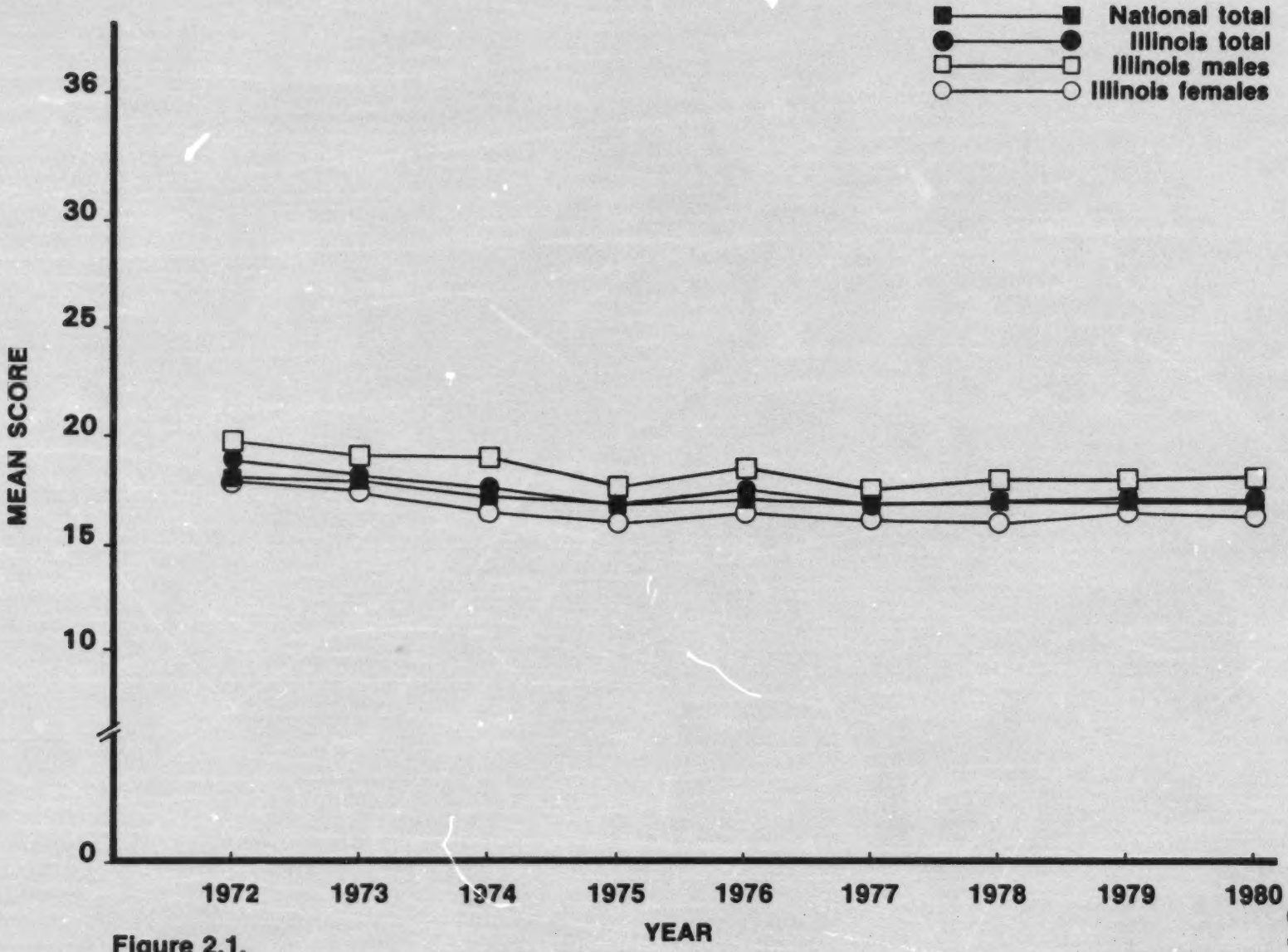


Figure 2.1.
ACT mean scores in social studies by year.

Discussion

In order to interpret the social studies results presented above, it must be kept in mind that the tests are quite different in terms of content, the proportion of items testing reading and knowledge, and the intended difficulty level of the instruments.

One recent issue in the field of testing focuses on how well the test matches the materials to which students have been exposed. In attempting to test either social studies or civics, it should be noted that high school social studies courses are often elective. According to the 1977 Illinois State Board of Education Census of Secondary School Course Offerings, in a single year, less then 7 percent of Illinois students enroll in United States or world history courses; less than 5 percent enroll in economics; less than 2 percent enroll in "civics"; less than 1 percent in sociology; and less than 1 percent in social issues types of courses. In a student questionnaire attached to the 1978 Illinois Inventory of Educational Progress, 48 percent of the juniors responding indicated "hardly at all" when asked, "How often do you talk about government or politics in your class?" It should be added, however, that there is a legal requirement for eighth graders and high school students to pass a test on the state and federal constitutions and the display of the flag to be promoted or graduate. This information suggests that students have limited exposure to the type of knowledge accounting for portions of the social studies and civics tests reviewed in this report.

The second problematic aspect of testing social studies and civics performance of high school students is determining the source of information being utilized by the student to answer the questions. Familiarity with the language and style of social studies reading materials may be obtained through environments other than the school. Even the media contributes to the social studies performance of students. This may be especially true in the area of "civics" where the course deals with the rights, duties, and issues of citizenship. Thus, the influence of schools on student performance on these tests cannot be separated from other influences when examining the results. The reader should keep these issues in mind when reviewing the following conclusions.

In general, the performance of Illinois students has declined as evidenced in both the Decade Study and the ACT results. Yet for the ACT, the decline has not been statistically significant, and for the last five years scores on the ACT have stabilized. On tests of moderate difficulty--the IIEP and the High School and Beyond sophomore test--students are able to answer a majority of the items correctly. Student performance is slightly higher on social studies items based on reading, rather than recall of specific knowledge.

For the Decade Study test, with its unknown curricular validity, general performance is significantly lower for juniors than it was eleven years ago. However, on the social studies knowledge items related to matters more likely to have been covered in classes, such as on the IIEP, student performance levels approach sixty percent correct. Three years ago, high school juniors demonstrated a good general knowledge of the material covered by the IIEP. This test, as reviewed by teachers at that time, was considered to have some match between the test and course content. Of the tests reviewed here, then, the IIEP performance is the best indicator of the knowledge acquired by students taking social studies classes.

CHAPTER THREE

MATHEMATICS

Introduction

The mathematics achievement results discussed in this report are from five sets of tests: (1) fourth, eighth and eleventh grade Illinois Inventory of Educational Progress (IIEP) tests; (2) tenth and twelfth grade High School and Beyond tests (including 18 items which are identical on both tests, and are called the "overlap test" in this report); (3) eleventh grade Decade Study test; (4) twelfth grade Scholastic Aptitude Test (SAT); and (5) twelfth grade American College Test (ACT). The tests differ not only in terms of grade level and years of administration, but also in terms of mathematics content, difficulty level, and other dimensions. Results reported differ considerably for general mathematics versus advanced mathematics. General mathematics includes elementary school mathematics, first semester algebra, and first semester plane geometry. Advanced mathematics includes second semester algebra and geometry, higher levels of algebra and geometry, trigonometry, and calculus.

The mathematics tests of the Illinois Inventory of Educational Progress (IIEP) and the High School and Beyond study were intended to be tests of general mathematics up to the end of first semester algebra and geometry. The mathematics tests of the Decade Study were constructed to include the general mathematics of junior high school and high school algebra, geometry, trigonometry, and calculus, with emphasis on advanced mathematics. The American College Test (ACT) and the Scholastic Aptitude Test (SAT) were constructed to measure developed mathematical ability and logical quantitative reasoning. The ACT and SAT tests contain items related to general mathematics and high school mathematics, but emphasize complex problem solving and logical quantitative inferences not encountered in many courses.

The informational brochures of the ACT and SAT indicate that those tests emphasize mathematical reasoning ability which would probably be closer to problem solving than factual knowledge. Analysis by experts indicates that the IIEP tests emphasize factual knowledge and computation, while the High School and Beyond and Decade Study tests emphasize application. Table 3.1 shows the percentages of items on the IIEP, High School and Beyond, and Decade Study tests which were identified by conceptual analysis as relating to each mathematical skill.

Table 3.1
Percentages of Items Measuring
Each Mathematics Skill
for Each Test

Skill	IIEP	High School and Beyond	Decade Study
Factual knowledge/ computation	65-75%	28-37%	31-42%
Problem solving/ application	25-35%	63-72%	58-69%

The IIEP and High School and Beyond tests are similar in the proportion of items measuring the various topics, except for the IIEP emphasis on personal and consumer mathematics. The IIEP and High School and Beyond tests do not measure advanced mathematics. However, the Decade Study test contains many such items (Part I, 53 percent; Part II, 38 percent). Table 3.2 shows the percentages of items (by tests) on each mathematical topic.

Table 3.2
Percentages of Items on Each
Mathematics Topic for Each Test

Topics	Grade 11 IIEP	High School and Beyond Soph	High School and Beyond Senior	High School and Beyond Overlap	Decade Study Part I	Decade Study Part II
Whole numbers, fractions decimals, and percentages	15-25%*	34%	53%	61%	17%	17%
Measurement	0-10%	11%	9%	11%	--	--
Graphs, statistics, and probability	0-10%	5%	13%	11%	--	12%
Basic algebra	15-25%**	39%	22%	17%	25%	29%
Basic geometry	0-20%**	11%	3%	-0-	5%	4%
Advanced mathematics	--	--	--	--	53%	38%
Personal and consumer mathematics	20-40%**	--	--	--	--	--

*These topics are measured by many items on the fourth grade IIEP tests and fewer items on the eighth and eleventh grade IIEP tests.

**These topics are measured by few items in the fourth grade IIEP tests and more items on the eighth and eleventh grade IIEP tests.

An intuitive understanding of the characteristics of each test and the differences between them can be gained from inspection of typical items. Typical fourth grade IIEP items measuring the two mathematical skills are:

Factual knowledge/computation: "Which digit is in the 10's place in 4,263?" (Answer: 6)

Problem solving/application: "A sports car owner says that the car gets 22 miles per gallon of gasoline. How many miles could the car go on seven gallons of gasoline?" (Answer: 154 miles)

Typical fourth grade IIEP items measuring the mathematical topics are:

Numeration concepts: "Four and two-fifths is written as ____." (Answer: 4 2/5)

Whole numbers: "Find the difference: 2043 - 317 = _____." (Answer: 1726)

Consumer mathematics: "Mary earned $1.00 raking leaves. Candy bars cost 15 cents. How many candy bars can she buy with her money?" (Answer: 6)

Measurement: "In the United States we usually buy gasoline by the gallon. In France, where the metric system is used, people buy gasoline by the _____." (Answer: liter)

Typical eighth grade IIEP items measuring the two mathematical skills are:

Factual knowledge/computation: "- 2 x 12 = _____." (Answer: -24)

Problem solving/application: "John's parents bought a refrigerator for $375. If they pay $20 per month for two years, how much more than $375 will the refigerator cost them?" (Answer: $105)

Typical eighth grade IIEP items measuring various mathematical topics are:

Whole numbers: "4^3 = _____." (Answer: 64)

Consumer mathematics: "Ruth has savings of $17.25. She wants to buy the following things: skirt - $9.00; belt - $3.00; book - $2.50; records - $4.98. How much more money does she need before she can buy all of these items? (Do not include sales tax in your answer.)" (Answer: $2.23)

Fractions and decimals: "1/2 x 1/4 = _____." (Answer: 1/8)

Measurement: "The number of centimeters in one meter is _____." (Answer: 100)

The similarities and differences among the high school mathematics tests can probably be seen best by studying sample algebra items from the tests:

IIEP algebra item: "(4x + 2) (x-5) = _____." (Answer: $4x^2 - 18x - 10$)

Decade Study (Part I) algebra item:
Simplify completely:

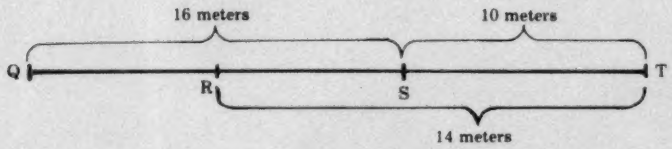
$$\frac{\frac{x-1}{x}}{\frac{x^2-1}{x}}, \text{ where } x>1.$$

(A) $\frac{1}{x}$ (B) $x - 1$ (C) 0 *(D) $\frac{1}{x+1}$ (E) $\frac{1}{x-1}$

High School and Beyond overlap test algebra item:

Directions: Each problem in this section consists of two quantities, one placed in Column A and one in Column B. You are to compare the two quantities and mark oval

A if the quantity in Column A is greater;
B if the quantity in Column B is greater;
C if the two quantities are equal;
D if the size relationship cannot be determined from the information given.



QT is a line segment.

Column A	Column B	
Length of segment ST above	Length of segment RS above	★ (A) (B) (C) (D)

ACT algebra item:

What values of x and y satisfy the following simultaneous equations?

$3y = x + 4$
$6x + 2y = 16$

A. x = -2:y =2
B. x = 2;y = -2
C. x - -2;y = -2
*D. x = 2:y = 2
E. None of these

Information presented below will be used to answer two questions: (1) How well do Illinois students of 1981 achieve compared to Illinois students of the 1970's?; and (2) How well do Illinois students achieve compared to students in other parts of the United States? Sub-questions are: What is the status of achievement in Illinois for: (1) general mathematics, (2) advanced mathematics, and (3) complex mathematics problem solving?

Illinois Inventory of Educational Progress

The IIEP mathematics tests measure mathematics up through first semester algebra and geometry, not advanced mathematics which the average student has not been taught in school.

The IIEP mathematics test results are described first for general mathematics as a whole, second for two types of mathematics skills, and third for nine mathematics topics. The two mathematics skills are:

1. factual knowledge/computation
2. problem solving/application.

The nine topics are:

1. numeration concepts (place value, approximating, and rounding off numbers)
2. properties of numbers and operations
3. whole numbers
4. fractions, decimals, and percentages
5. measurement
6. graphs, statistics, and probability
7. basic algebra
8. basic geometry
9. personal and consumer mathematics.

General mathematics results on the IIEP are presented by grade level in the following order: fourth grade, eighth grade, and eleventh grade.

Figure 3.1 shows percentages of IIEP mathematics trend items answered correctly by grade level and year of administration. Overall, fourth grade mathematics scores tended to increase each year from 1976 to 1980 and to decline somewhat between 1980 and 1981. Preliminary analyses of 1982 data show results that seem to be equivalent to results from 1981.

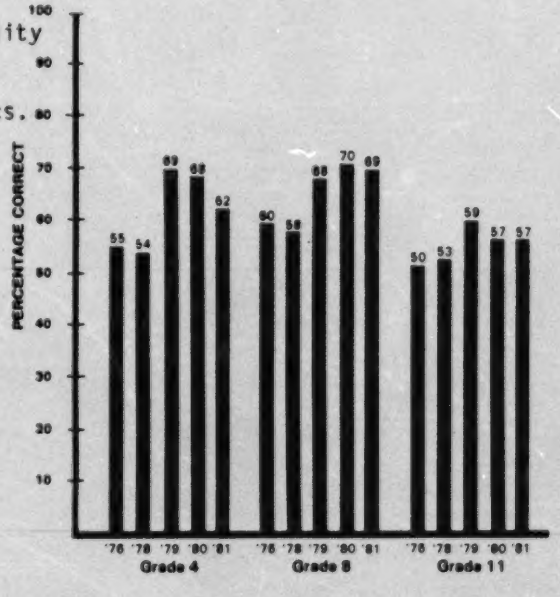


Figure 3.1.
Percentages of Illinois Inventory of Educational Progress trend items answered correctly in mathematics by grade level and year of administration.

Figure 3.2 shows that, in terms of mathematics skills, fourth grade scores from 1976 to 1981 have been consistently higher for factual knowledge/computation than for problem solving/application. However, scores for problem solving increased considerably from 1976 to 1980, while scores for factual knowledge/computation remained steady. Scores declined for both types of skills from 1980 to 1981.

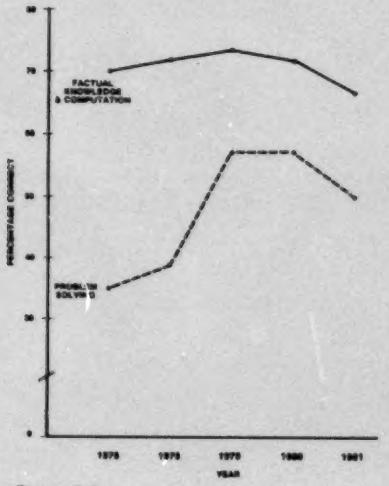


Figure 3.2.
Percentages of fourth grade trend mathematics items answered correctly by type of ability and year of administration.

The mathematics topics included in the assessment of fourth graders from 1976 to 1981 were numeration concepts, whole numbers, and consumer mathematics. Measurement was assessed from 1976 to 1980. As shown in Figure 3.3, scores increased for all four topics from 1976 to 1980, but declined from 1980 to 1981 for the three topics tested. Measurement was not tested extensively enough in 1981 to be included in discussion of the trends.

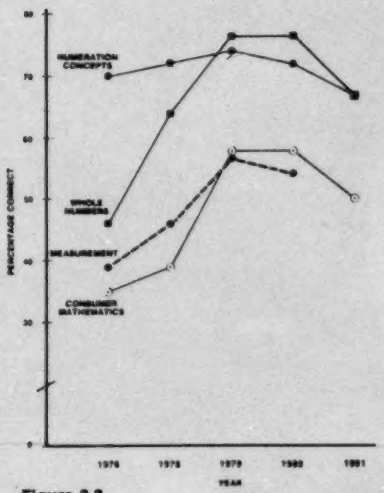


Figure 3.3.
Percentages of fourth grade trend mathematics items answered correctly by topic and year of administration.

Figure 3.1 shows that overall eighth grade mathematics performance improved between 1976 and 1981. Preliminary analyses indicate that 1982 results have dropped back to the 1976 level.

Figure 3.4 shows that, in terms of types of mathematics abilities, scores for the eighth grade level increased from 1976 to 1981 for factual knowledge/computation as well as problem solving/application. However, there was a decline in performance on factual knowledge/computation from 1980 to 1981.

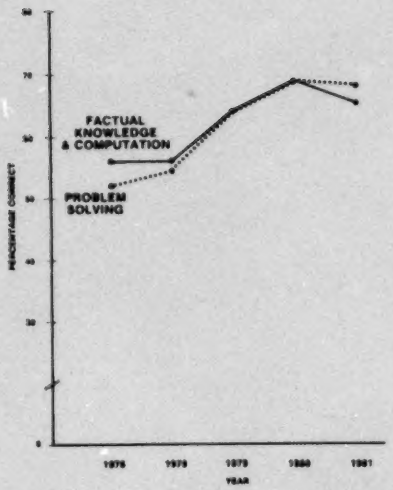


Figure 3.4.
Percentages of eighth grade trend mathematics items answered correctly by type of ability and year of administration.

Regarding mathematics topics, whole numbers and consumer mathematics were included at the eighth grade level from 1976 to 1981; fractions and measurement were included at the eighth grade level from 1976 to 1980. Figure 3.5 shows that scores on all four topics increased from 1976 to 1980. Scores remained high for consumer mathematics from 1980 to 1981, but declined slightly for whole numbers. Fractions and measurement were not tested extensively enough to show meaningful trends between 1980 and 1981.

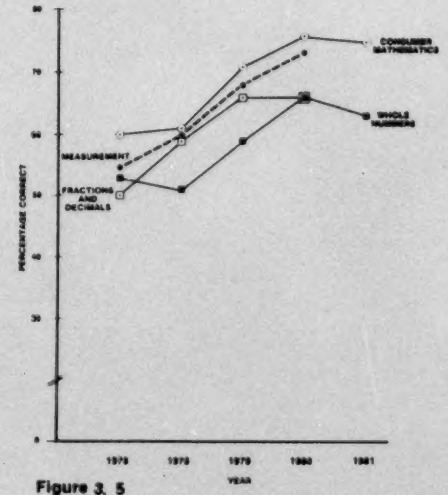


Figure 3. 5
Percentages of eighth grade trend mathematics items answered correctly by topic and year of administration.

Figure 3.1 shows that overall eleventh grade mathematics performance improved from 1976 to 1981. Preliminary analyses indicate that 1982 results are significantly lower than 1979 scores but significantly higher than 1976 scores.

Figure 3.6 shows that, in terms of mathematics skills, scores for problem solving/application increased from 1976 to 1979 and remained stable from 1979 to 1981. Scores for factual knowledge/computation increased from 1976 to 1980 but declined from 1980 to 1981.

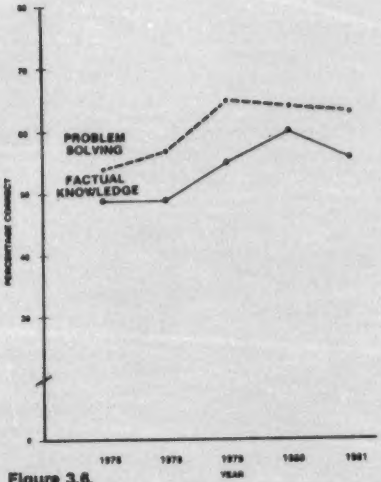


Figure 3.6.
Percentages of eleventh grade trend mathematics items answered correctly by type of ability and year of administration.

Figure 3.7 shows that, in terms of mathematics topics, consumer mathematics, fractions, and algebra were included in the assessment of eleventh graders from 1976 to 1981. Measurement was tested from 1975 to 1980. Scores increased from 1976 to 1980 for all four topics. Scores remained high for consumer mathematics from 1980 to 1981, but declined for fractions and algebra. Measurement was not tested extensively enough to show meaningful trends from 1980 to 1981.

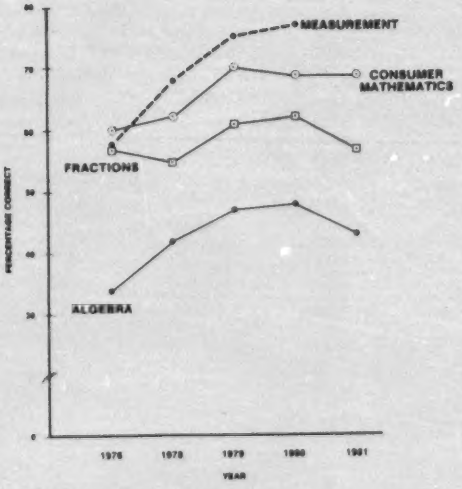


Figure 3.7.
Percentages of eleventh grade trend mathematics items answered correctly by topic and year of administration.

Decade Study Test

The Decade Study mathematics test was administered to grade eleven students in both 1970 and 1981. The test was constructed to measure advanced mathematics--algebra, geometry, advanced algebra, advanced geometry, trigonometry, and calculus. Half of the items measure content which the average student has not been taught in school.

Results on the Decade Study mathematics test allow only one comparison, which is between school means for 1970 and 1981. Table 3.3 shows that the means were significantly lower on both parts of the tests in 1981 than in 1970.

Table 3.3
Decade Study School Means
and Standard Deviations

	1970		1981	
Subtest	Mean	S.D.	Mean	S.D.
Part I (36)*	11.8 (33)**	1.6	11.1 (31)	1.5
Part II (24)	9.0 (38)	1.0	8.0 (33)	0.9

*Number of items on each subtest is shown in parentheses.

**Percentages of items correct are shown in parentheses.

High School and Beyond

The High School and Beyond general mathematics tests were administered to grade ten and twelve students across the nation in the spring of 1980. The High School and Beyond test provides the only valid data for making comparisons between Illinois and other parts of the United States pertaining to general mathematics.

There were three 1980 High School and Beyond mathematics tests, the (1) sophomore test; (2) senior test; and (3) overlap test. Results were obtained for Illinois, other North Central states, New York, other Northeastern states, the South, the West, and the United States as a whole. Four types of comparisons are reported: (1) Illinois sophomores versus sophomores in the other geographical areas; (2) Illinois seniors versus seniors in the other geographical areas; (3) sophomores versus seniors within each geographic region; and (4) the gains in Illinois from sophomores to seniors versus the gains in each other geographic region. Mean scores on the sophomore and senior tests are shown in Table 3.4.

Table 3.4
High School and Beyond
Mean Test Scores for Students
in Public Schools - Spring 1980[a]

Geographical Region	Sophomore Test (38)[b]	Senior Test (32)
Illinois	18.7 (49.2)[c]	19.2 (60.0)
Other North Central	19.7 (51.8)	19.9 (62.2)
New York	19.6 (51.6)	20.7 (64.7)*[d]
Other North East	19.3 (50.8)	19.9 (62.2)
South	16.6 (43.7)*	17.4 (54.4)*
West	19.3 (50.8)	19.5 (60.9)
Total United States	18.5 (48.7)	19.1 (59.7)

[a] All means are weighted to better reflect the population values because of the two-stage stratified sampling design used.

[b] Numbers in parentheses indicate number of items per test.

[c] Numbers in parentheses indicate percentages of items correct.

[d] Asterisks indicate scores significantly different at the .01 level than scores for Illinois students.

Table 3.4 shows that Illinois sophomores scored significantly higher than sophomores in the South. Scores of Illinois sophomores were not significantly different from scores of sophomores in any other geographical region. In addition, Illinois seniors scored significantly higher than seniors in the South, but significantly lower than seniors in New York. Scores of Illinois seniors were not significantly different from scores of seniors in any other geographical region.

Results on the eighteen-item overlap test (identical items administered to both sophomores and seniors) show that seniors in Illinois and in every other geographical region scored significantly higher than their sophomore counterparts. The gains from the sophomore to senior level appear similar in all parts of the country. For each region, seniors tended to answer correctly between one and two items more on the eighteen-item overlap test than did sophomores.

American College Test and Scholastic Aptitude Test

The American College Testing Program (ACT) and the Scholastic Aptitude Test (SAT) are designed to measure developed mathematics ability and aptitude for college-level mathematics. The ACT and SAT test developers describe the tests as tests of logical quantitative reasoning and state that the tests are not mathematics achievement tests.

Illinois students score at approximately the same level as their peers across the United States on the ACT. There are no significant differences in any years from 1972 to 1980. Figure 3.8 shows the results, which are based on an ACT scale of 1 to 36.

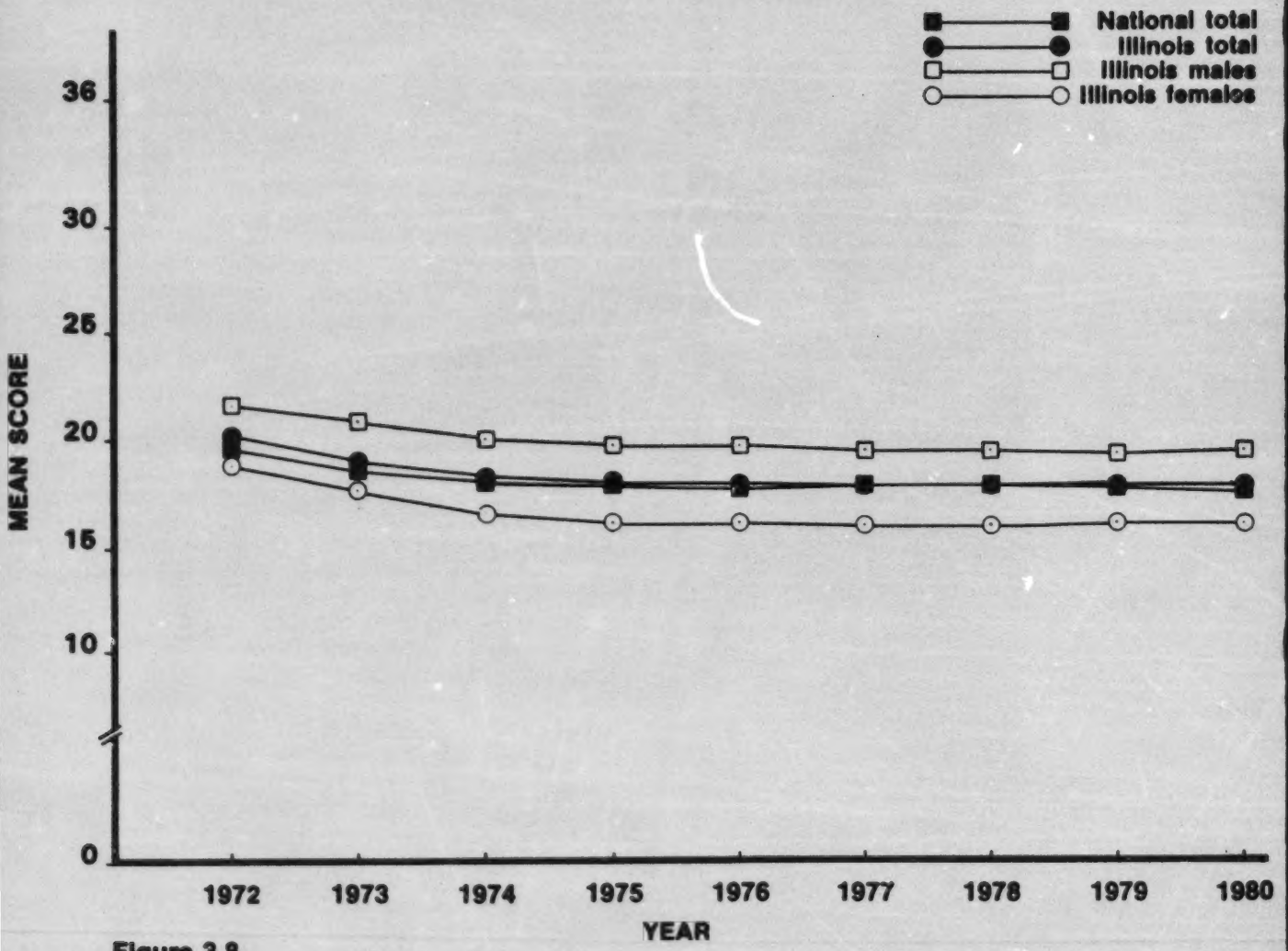


Figure 3.8.
ACT mean scores in mathematics by year.

Figure 3.8 shows that ACT mathematics scores for Illinois were essentially stable from 1972 to 1980. On the ACT as well as the SAT (See Figure 3.9), females scored consistently below males both in Illinois and across the nation.

There has been considerable debate as to whether SAT scores dropped during the 1960's and stabilized during the 1970's, or whether there has been a slow but continuing decline. The mean scores for the SAT scores in mathematics since 1972 are given in Figure 3.9. Figure 3.9 shows that from 1972 to 1980, there has been a 22-point drop for the United States as a whole, but only a 1-point drop for Illinois. There was a 9-point drop for the Midwest from 1973 to 1980.

Illinois college-bound seniors who take the SAT tend to be more elite than students who take only the ACT. Illinois students taking the SAT tend to apply to exclusive private and public universities outside Illinois. Of the nearly one million students who take the SAT annually, only 23,500 are from Illinois. By comparison, 101,000 Illinois students take the ACT each year. Because the Illinois sample appears to be different from SAT samples of students across the United States generally, no valid comparisons can be made.

Figure 3.9 shows the relative stability of SAT scores when the size of the scale is taken into consideration. For example, during the eight-year period from 1972 to 1980, the largest difference occurred between the low score of 507 in 1976 and 1979 versus the high score of 513 in 1973.

While the Illinois SAT mean score did not change from 1972 to 1980 (as shown in Figure 3.9), Table 3.5 indicates that there has been a decline in the proportions of students in the higher ranges from 1972 to 1980. The percentage of Illinois students scoring in each 50-point range is given in Table 3.5. Data cells are circled for the years in which a smaller proportion of Illinois students scored in the indicated range, as compared to the 1972 proportion. For example, for the 650-699 score range, the years 1974, 1975, 1979, 1980, and 1981 are circled because only 7 percent of the students scored in that range during those years as compared to 8 percent in 1972.

Table 3.5
Percentages of Illinois Students
at Various SAT Score Intervals by Year

Score Interval	1972	1973	1974	1975	1976	1977	1978	1979	1980
750 - 800	1	2	2	2	2	2	2	2	1
700 - 749	4	4	4	4	4	4	4	4	4
650 - 699	8	8	(7)	(7)	8	8	(7)	(7)	(7)
600 - 649	11	11	11	11	11	11	11	11	11
550 - 599	16	(14)	(14)	(13)	(15)	(13)	(13)	(14)	(14)
500 - 549	16	16	16	16	(15)	16	17	(15)	16
450 - 499	15	16	15	15	15	15	15	15	15
400 - 449	13	12	12	12	12	12	12	13	13
350 - 399	9	9	10	10	10	10	9	10	9
300 - 349	6	6	6	6	7	6	6	6	6
250 - 299	2	2	2	2	3	2	3	2	3
200 - 249	0	0	0	1	0	0	0	0	0

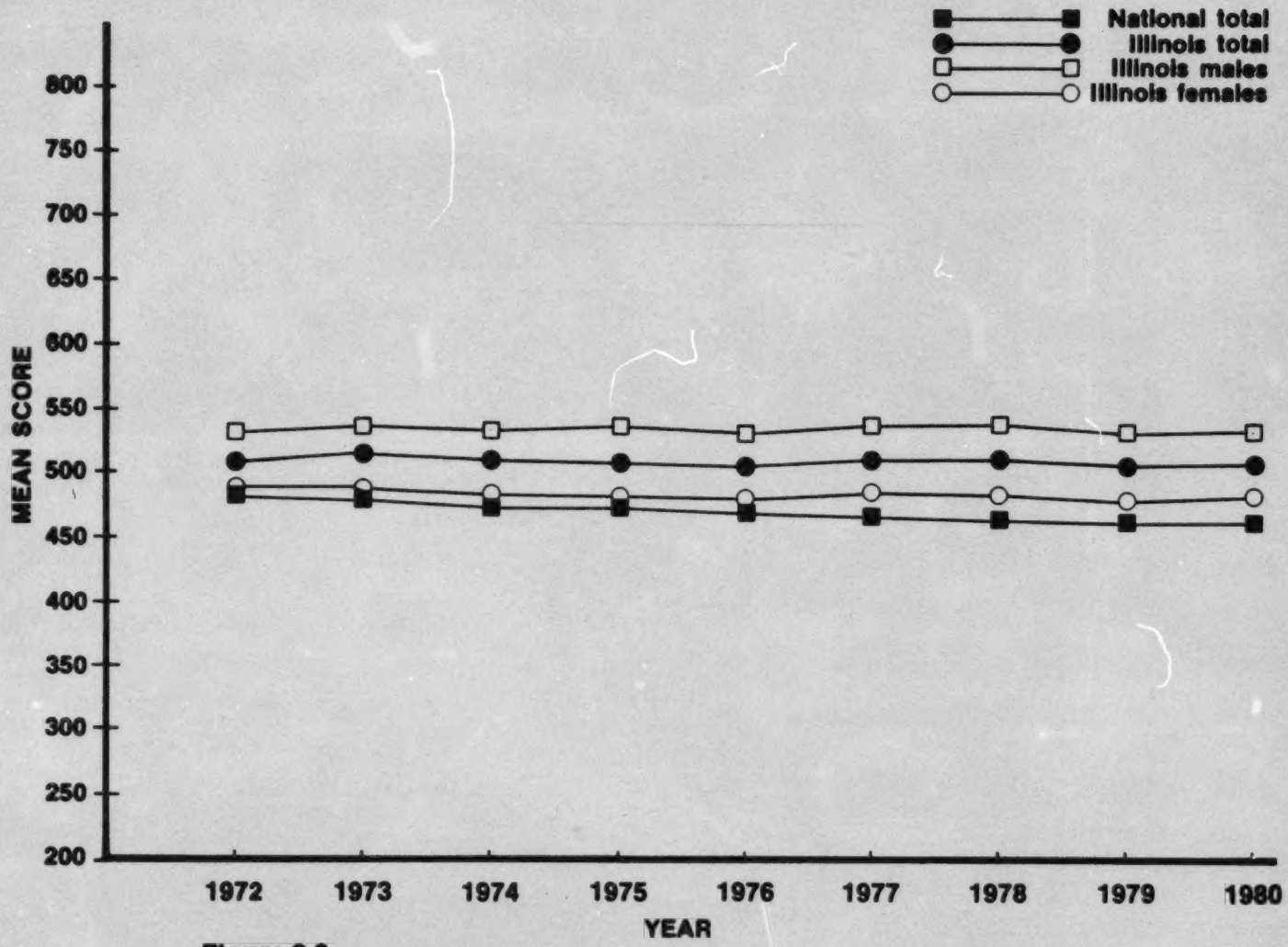


Figure 3.9.
SAT mean scores in mathematics by year.

The trend shown in Table 3.5 parallels findings for the United States as a whole. According to Diane Ravitch:

> An extraordinary thing has happened to achievement levels since the mid-1960s. SAT scores, which had been a consistent measure of verbal and mathematical skills, have dropped dramatically. Median verbal scores have fallen from a high of 478 in 1963 to a new low of 424 in 1980; in the same period mathematical scores fell from 502 to 466. On both tests girls' scores dropped more sharply than those of boys. The first reaction to the score drops was to attribute them to the fact that large numbers of minorities, females, and low-income students joined the college-bound pool during this time of expansion. But, in fact, the composition of the test-takers has been fairly stable since 1970. It is more telling that the number and proportion of high-scoring students have fallen precipitously; the number of seniors who scored over 650 fell from 53,800 (5.3 percent) in 1972 to 29,000 in 1980 (2.9 percent). The shrinkage of the top-scorers has proceeded steadily since the mid-1960s, and obviously is unrelated to the overall composition of the test-taking group. ("Schools We Deserve." The New Republic, April 18, 1981, 184, p.24.)

What may be more of note than the SAT mathematics scores for Illinois students as a whole is that SAT mathematics scores for Illinois males are consistently and significantly above those for females, and that the difference is as much in 1980 as it was eight years ago in 1972 as shown in Figure 3.9. The 50-point difference in male versus female SAT scores in Illinois parallels the 45-point difference in the United States as a whole.

Questionnaire Data

Data obtained on four questionnaires, as well as achievement data from the five tests discussed in this report, were used in preparing this discussion section. The four questionnaires used were the IIEP teacher survey, the IIEP mathematics committee survey, the 1977 Illinois State Board of Education Census of Secondary School Course Offerings, and the student questionnaires of the High School and Beyond study. The IIEP teacher survey was developed in 1977 to verify the content validity of the IIEP, supply an additional perspective on the test results, and provide a standard of teacher judgments with which to compare student performance. One mathematics teacher from each school whose students took the IIEP was asked to: (1) report for each test item whether students had been taught the content being measured; (2) judge whether the item was of appropriate difficulty level; and (3) estimate the percentage of students expected to answer the item correctly. Two validation research projects have been conducted and have supported the general uses and results of the IIEP teacher questionnaire.

The questionnaires on the mathematics tests in the High School and Beyond Study and the Decade Study were sent to the ten Illinois educators of the IIEP mathematics committee. Working independently and without knowledge of the test results, the committee members answered two questions for each item: (1) "To what extent have students been exposed to the content being measured by the item?"--The response choices were "not at all," "minimally," "adequately," and "heavily"; and (2) "What percentage of students do you

estimate will answer the item correctly?" After the means and standard deviations were computed for each item, student performance was checked against the judged exposure level. After the means and standard deviations were computed for committee responses to the second question, the actual percentages correct (student results) were checked against the estimated percentages correct (committee estimates).

In 1977, the Research and Statistics Section of the Illinois State Board of Education in cooperation with the Illinois Association for Supervision and Curriculum Development conducted the Census of Secondary School Course Offerings, Enrollments, and Cocurricular Activities. This was the first such statewide census in Illinois. The Census was designed to produce normative data relative to offerings and enrollments in Illinois public secondary schools and to establish a source of data on secondary school curriculum at the peak of public high school enrollment.

As part of the High School and Beyond study, students were asked how many years of mathematics they had studied in high school and what mathematics courses they had taken. The student responses were used for comparisons with the data from the 1977 Illinois State Board of Education Census of Secondary School Course Offerings, estimates of the mathematics committee, student results on the various tests, and correlations with student achievement.

Thus, in regard to what students are taught, two types of data pertain to the match between what was taught and what was tested. First, the IIEP teacher questionnaires and the mathematics committee questionnaires provided judgmental data on whether students had been taught what was on the IIEP, High School and Beyond, and Decade Study tests. Second, the Census of Secondary School Course Offerings and the student questionnaires of the High School and Beyond Study provided reports on the percentage of students who had taken specific high school courses in mathematics.

Judgments of teachers on the IIEP teacher questionnaire were that the average student had been taught 95 percent of the content measured by the IIEP tests. The lowest estimated percentage of content taught for any of the twelve IIEP mathematics tests (tests administered in each of four years for each of the three grade levels) was 80 percent.

Judgments on the mathematics committee questionnaires were that the average student had been taught 60 percent of the mathematics content measured by the High School and Beyond study and 39 percent of the mathematics content tested on the Decade Study test.

Results on the 1977 Census of Secondary School Course Offerings indicated the following statewide student enrollment figures: first semester algebra, 25 percent; plane geometry, 12 percent; second semester algebra, 11 percent; trigonometry, 7 percent; and calculus, 1 percent.

The High School and Beyond Study student questionnaire for seniors shows that the percentages of seniors who had taken mathematics courses was as follows: first semester algebra, 82 percent; plane geometry, 58 percent; second semester algebra, 44 percent; trigonometry, 24 percent; and calculus, 7 percent.

Discussion

The data appear to indicate that there are two types of developed abilities in mathematics--factual knowledge and problem solving. Furthermore, achievement is different for general mathematics as compared to advanced mathematics. Also, there are significant differences for males compared to females.

It appears that most students master general mathematics if adequately taught. Teachers report that there was more emphasis on general mathematics in 1980 as opposed to the early 1970's. IIEP trend data show that student success was also higher in 1981 than it was in 1976. It appears that the slightly below-average students of 1981 are learning what their counterparts of the mid-1970's did not.

Results for advanced mathematics follow a similar pattern. Combined results of the four questionnaires described above indicate that students are successful in advanced mathematics to the extent that they take courses in advanced mathematics. In the Decade Study, students were asked how many high school courses they had taken in mathematics. The more courses students took, the more successful they were on the test.

Analyses of SAT results by Diane Ravitch, Julian Stanley, and others suggest that mathematics achievement of the top students has not declined, but that achievement of students in the other upper ranges has declined. Such a decline could explain the lower scores in 1981 compared to 1970 on the Decade Study test.

Recent reports of the College Board, developers of the SAT, indicate that females are taking more mathematics courses in 1981 than did females of the 1970's. However, males outperformed females on the SAT as much in 1981 as in 1972. Data from programs to identify fifth and sixth grade students who are gifted in mathematics must be considered. At the fifth and sixth grade levels, about twice as many boys as compared to girls are identified as gifted in mathematics. The results are true not only for the programs of Julian Stanley, but also for the Illinois Gifted Screening Program. These results cannot be explained by differential school experience in mathematics.

The above discussion should not lead to unwarranted conclusions. For example, one should not conclude from the results of the significant relationship between number of mathematics courses taken and scores on mathematics tests that achievement of all students can be improved considerably by forcing students to take advanced mathematics courses. While it is likely that many students could learn more mathematics than they do at present if they were challenged more, many others would probably learn only a little more, and still others would not achieve any more than they do at present. And one should certainly not conclude from the sex-related data that males are innately and unalterably superior to females in mathematics ability. It does appear that developed mathematics ability to do complex problem solving is not totally dependent upon differential study of mathematics in school. But, there are certainly innumerable non-school environmental factors that could account for all or some of the differences.

CHAPTER FOUR

SCIENCE

Introduction

This chapter is concerned with science achievement and answers two questions: How does Illinois student achievement in 1981 compare with student achievement in the 1970's? How does Illinois student achievement in science compare with national results?

With respect to achievement on the part of Illinois students, there are two data sources. The Illinois Inventory of Educational Progress (IIEP) assessed student achievement in general science in 1977 and 1981. In advanced science, the Decade Study test included a science section. The Decade Study test was initially administered in 1970 and again in the fall of 1981.

At the national level, there are two test instruments with which to make comparisons, one in general science (the High School and Beyond test) and one in advanced science (the ACT).

Illinois Inventory of Educational Progress

This section of the report describes results from the Illinois Inventory of Educational Progress tests of general science which were administered at the fourth, eighth, and eleventh grade levels in 1977 and 1981.

The IIEP science tests are concerned with three topics:

1. life science--questions which assess student knowledge concerning living things (germ theory, transformations, heredity, evolution, and ecology).

   The following is an example of a life science item:

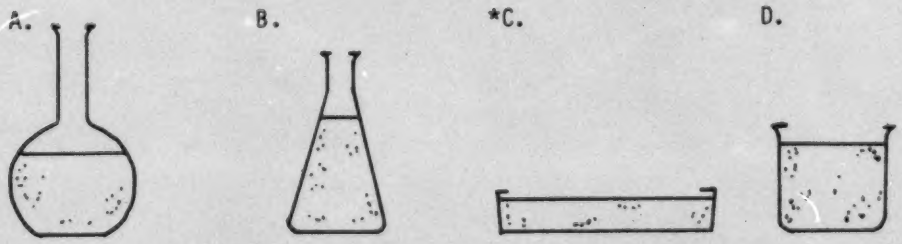
   Most cells contain all of the following EXCEPT

   A. nucleus.
   *B. tissue.
   C. membrane.
   D. cytoplasm.

2. physical science--questions which assess student knowledge concerning matter, mechanics, waves, electricity, and magnetism.

   The following is an example of a physical science item:

   The same amount of water is poured into each of the containers shown below, and they are left uncovered in a warm room. After a day, which container will have the LEAST amount of water left in it?



3. scientific methodology--questions which assess student cognitive skills, some simple and some complex, used by scientists but applicable to other problem-solving situations which deal with scientific inquiry (i.e., observation, classification, controlling data, and interpretation of data).

   The following is an example of a scientific methodology item:

   If a scientist needs to conduct an experiment, which of the following would indicate the proper sequence of tasks he/she should perform?

   *A. Experiment, record data, interpret the data.
   B. Record data, draw conclusions, write a hypothesis.
   C. Design an experiment, interpret the data, conduct the experiment.
   D. Interpret data, record the data, draw conclusions.

Figures 4.1, 4.2, and 4.3 present student performance on items measuring life science, physical science and science methodology at the fourth, eighth, and eleventh grade levels and differences in that achievement from 1977 to 1981.

Figure 4.1 shows the percentages correct of fourth grade items based upon each of the three topics assessed in both 1977 and 1981.

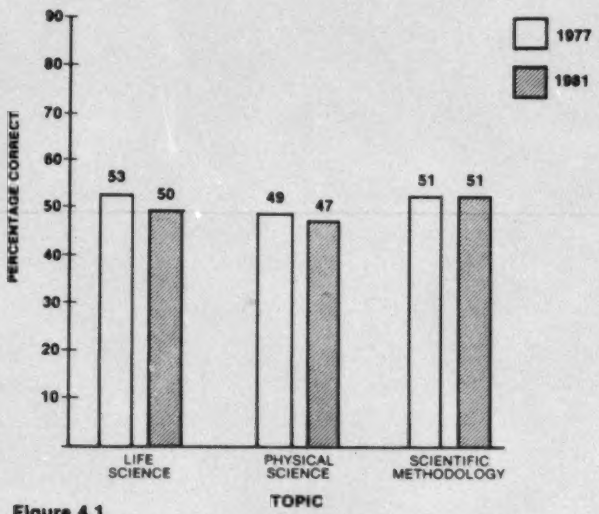


Figure 4.1.
Percentages of fourth grade science items answered correctly by topic and year of administration.

Figure 4.1 shows that fourth grade performance in physical science and scientific methodology was essentially unchanged between 1977 and 1981, but scores for life science declined significantly.

Figure 4.2 shows the percentages correct of eighth grade items based upon each of the three topics assessed in both 1977 and 1981.

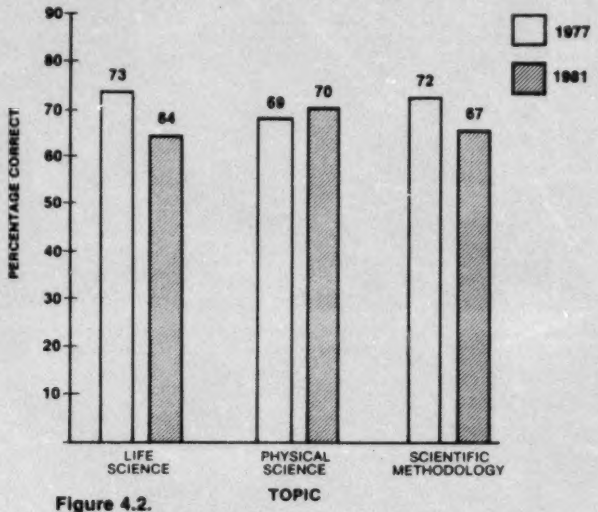


Figure 4.2.
Percentages of eighth grade science items answered correctly by topic and year of administration.

As shown in Figure 4.2, eighth grade performance on the physical science items was stable from 1977 to 1981, but there was a statistically significant decline in performance on the life science and scientific methodology items in 1981 as compared to 1977.

Figure 4.3 shows the percentage correct of eleventh grade items based upon each of the three topics assessed in both 1977 and 1981.

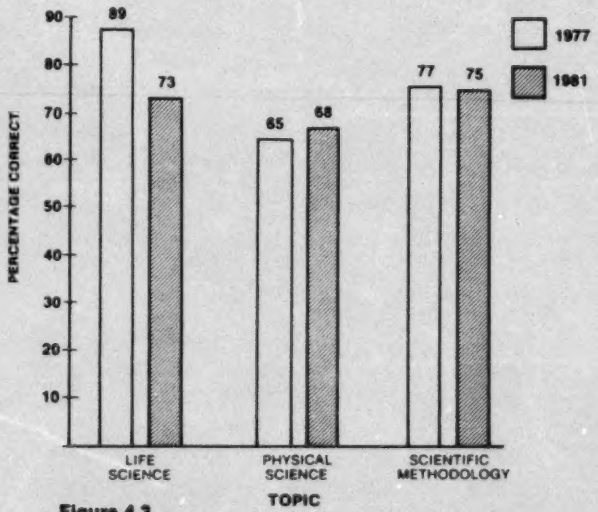


Figure 4.3.
Percentages of eleventh grade science items answered correctly by topic and year of administration.

As shown in Figure 4.3, eleventh grade performance on the scientific methodology items was relatively stable, but performance on the life science items declined significantly, while performance on the physical science items increased significantly.

In addition to assessing student achievement on the three science topics at each grade level, the tests were designed so that student achievement across grade levels could be compared. Therefore, a number of identical items were tested at the fourth, eighth, and eleventh grade levels in both 1977 and 1981. The comparisons across grade levels on these identical items are shown in Figure 4.4.

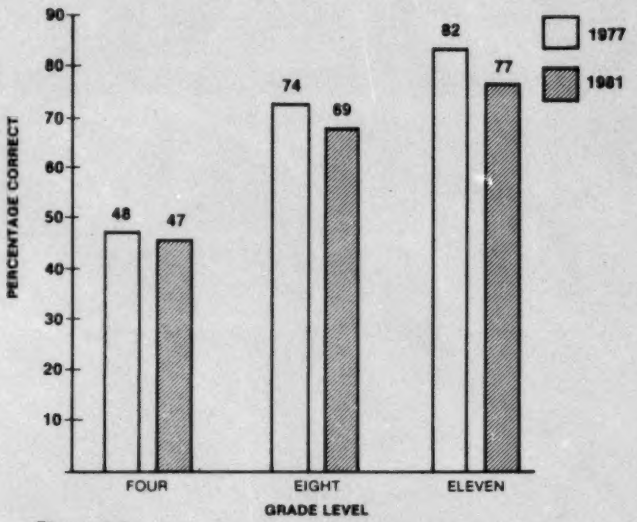


Figure 4.4.
Percentages of trend science items answered correctly by grade level and year of administration.

Figure 4.4 shows that, for all three grade levels, there was a drop of from one to five percentage points in science performance between the 1977 and 1981 administrations. The declines at the eighth and eleventh grade levels in 1981 were statistically significant. However, Figure 4.4 shows that the higher the grade level, the better the performance on the same science items. There was a greater increase in scores of eleventh graders as compared to fourth graders in 1977 (34 percentage points) than in 1981 (30 percentage points). There was also a greater increase in scores of eighth graders as compared to fourth graders in 1977 (26 percentage points) than in 1981 (22 percentage points). The difference in performance between grades eight and eleven for both 1977 and 1981 was eight percentage points.

The IIEP also included items administered at only one grade level, but in both 1977 and 1981. Results obtained on these items are shown in Figure 4.5.

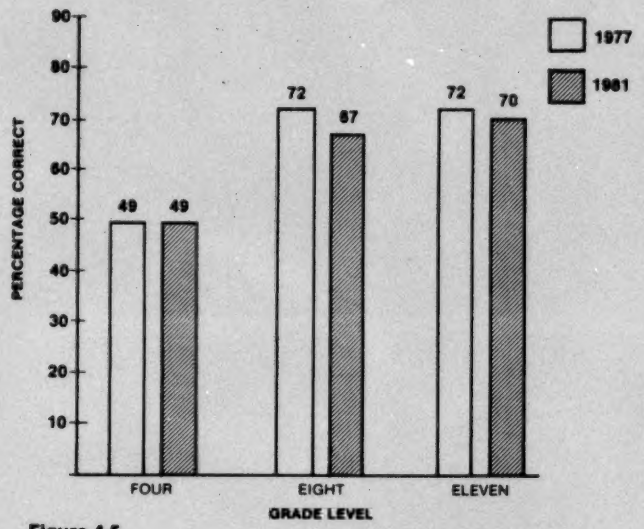


Figure 4.5.
Percentages correct of science items administered at only one grade level in both 1977 and 1981.

Figure 4.5 shows that the percentages of fourth grade and eleventh grade science items answered correctly were the same or essentially the same in 1977 and 1981. However, the percentage of eighth grade items answered correctly declined significantly in 1981 as compared to 1977.

Decade Study Test

The natural science section of the Decade Study test consists of twenty-two items grouped into four separate reading passages to assess life science (5 items), physical science (11 items) and scientific methodology (6 items). The test is an advanced science test and contains items on student knowledge and comprehension, as well as student ability to analyze, synthesize, and evaluate scientific concepts.

The Decade Study test was administered for the first time in 1970 and again in 1981. Table 4.1 shows Decade Study school means and standard deviations for science by year of administration.

Table 4.1
Decade Study School Means and Standard Deviations

Test	1970 Mean	1970 S.D.	1981 Mean	1981 S.D.
Natural Science (23)*	9.9 (43.0)**	1.1	7.9 (34.3)	0.8

*Number of items on the test is shown in parentheses.

**Percentages of items correct are shown in parentheses.

For the 1970 administration, student performance averaged 43 percent (9.9 items answered correctly) across the twenty-three items. In 1981, student performance declined significantly to 34.3 percent (7.9 items). Since the standard deviation was .8, the decline was more than two standard deviations below the mean.

Illinois student performance in 1981 with respect to the three science topics was 47 percent for life science, 39 percent for physical science, and 30 percent for scientific methodology.

High School and Beyond

The sophomore High School and Beyond Study contains a twenty-item section testing physical science (7 items), life science (6 items) and scientific methodology (3 items). The other four items assess student knowledge and comprehension of earth science and ability to apply principles of scientific technology.

According to Educational Testing Service, the test developers, items contained on the High School and Beyond test were taken mainly from the pool of items used in the National Assessment of Educational Progress (NAEP) and "focused on general principles of science that any alert young person might learn whether or not he or she had taken the relevant high school courses."

With respect to Illinois student performance on the science topics, Illinois scores were 55 percent for life science, 57 percent for physical science and 42 percent for scientific methodology.

Table 4.2 presents 1980 High School and Beyond sophomore results for the entire twenty-item test.

Table 4.2
High School and Beyond
Mean Test Scores for Sophomore Students
in Public Schools - Spring 1980[a]

	Illinois	Other North Central	New York	Other North East	South	West	Total United States
Mean Number Correct	11.1	11.6	11.3	11.0	10.0*[b]	11.3	10.9
Mean Percentage Correct	56%	58%	57%	56%	50%	57%	55%

[a]All means are weighted to better reflect the population values because of the two-stage stratified sampling design used.

[b]The asterisk indicates scores significantly different at the .01 level than scores for Illinois students.

Illinois scores were not significantly different from scores for the other geographical regions except the South. Scores on the test were 56 percent for Illinois, 55 percent for the nation as a whole, and 50 percent for the South.

American College Test

The American College Test (ACT) Natural Sciences Reading Test is a 52-item, 35-minute test that measures critical reasoning and problem-solving skills required in the natural sciences. Some of the items on the test can be answered solely from information contained in reading passages. Other items are dependent upon prior student knowledge about science. All items are multiple choice with four alternatives. The passages concern a variety of scientific topics and problems, with summaries of procedures and outcomes of experiments among the most common. The items require a student to interpret and evaluate scientific materials and, in particular, to understand the purposes of experimental hypotheses and generalizations which can be drawn from the experiments.

ACT results presented in Figure 4.6 indicate that high school seniors in Illinois and throughout the country are scoring essentially the same in 1981 as they did in 1970 on the natural science subtest.

Discussion

In 1981 as compared to 1977, there was a significant decrease in student performance in life science at the fourth, eighth, and eleventh grade levels. Results for physical science were stable for grades four and eight, but significantly higher in 1981 for grade eleven. Student performance on the scientific methodology items was stable for grades four and eleven, but significantly lower in 1981 for grade eight.

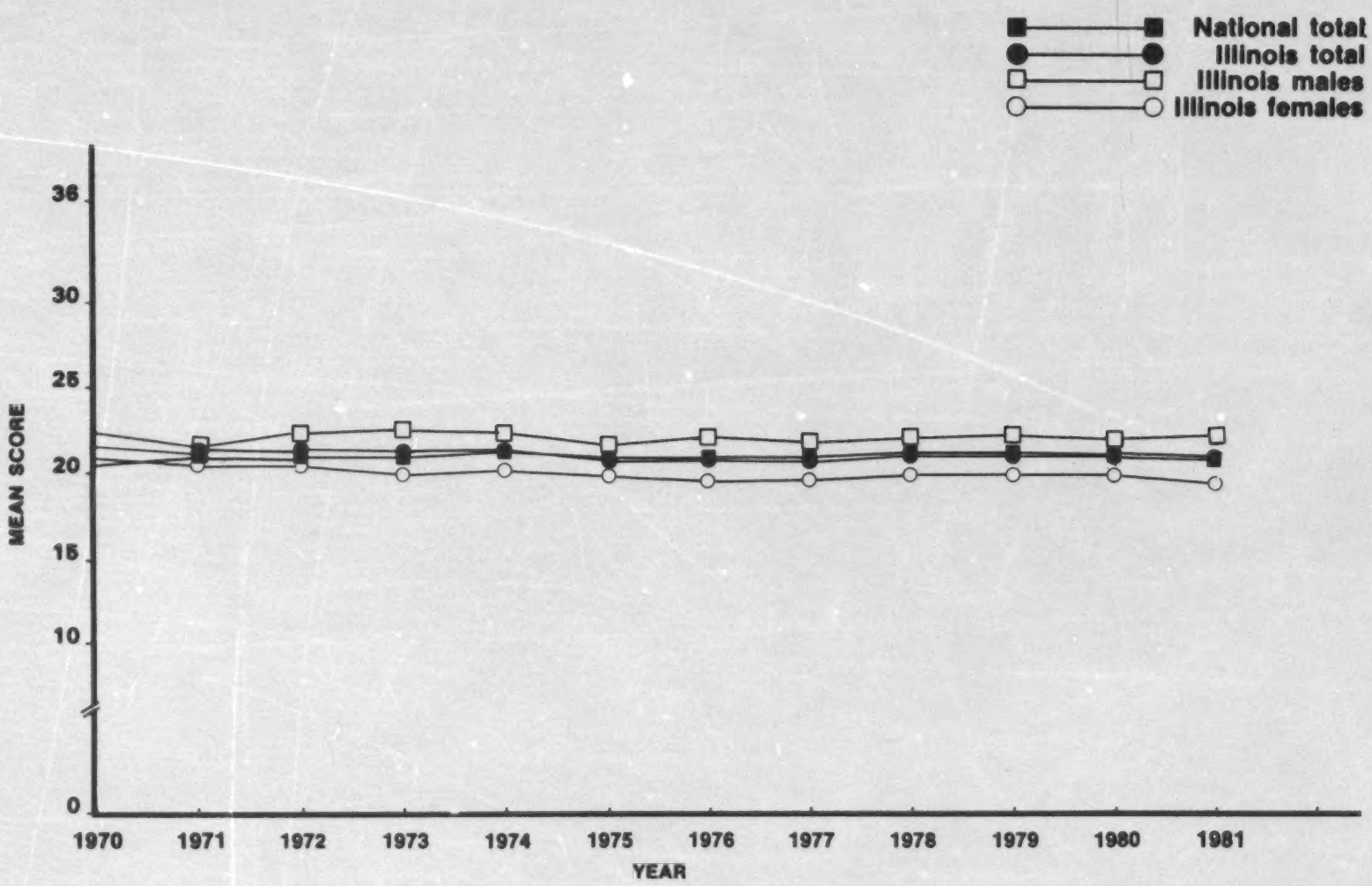


Figure 4.6.
ACT mean scores in natural science by year.

Results on the trend items (items administered in both 1977 and 1981 at all three grade levels), show that performance from 1977 to 1981 was stable for grade four, but declined between the 1977 and 1981 administrations for grades eight and eleven.

The science trend items from the IIEP can also be used to determine growth from fourth to eighth to eleventh grade since identical science trend items were tested in each of those grades. The results from 1977 show a 26 percentage point increase in performance of eighth as compared to fourth grade students and an 8 percentage point increase of eleventh as compared to eighth grade students. The results for 1981 reflect a smaller difference (as compared to 1977) of 22 percentage points of eighth as compared to fourth grade performance, but the same difference of 8 percentage points in comparing eleventh to eighth grade performance.

The results in comparing science achievement of Illinois to the nation as a whole reveal essentially similar performance. That is, students in Illinois are performing at the same level as their peers across the nation.

Performance with respect to the science topics seems related to student enrollment in science courses. Data from the 1977 Illinois State Board of Education Census of Secondary School Course Offerings indicate that only 40 percent of the high schools in the state require even one or two courses in science. Since science courses are predominately elective, many students are not exposed to high-school-level science. Census data show that during the 1976-77 school year 20 percent of the students were enrolled in a life science course and 10 percent in a physical science course.

The evidence from the data sources indicates that students preparing to go to college have maintained a plateau with regard to science achievement. However, generally fewer students are exposed to science courses, and as a result, fewer students understand and can apply scientific concepts. The plateau of ACT scores and the drop in the Decade Study results indicate the gulf is also widening among schools in their ability to produce students with a basic knowledge of science.

CHAPTER FIVE

ACHIEVEMENT AND PRODUCTIVITY

Background Variables and School Context Effects

Intensive analyses have been conducted on the 1981 IIEP data in terms of certain variables hypothesized to have an educational relationship. The following background and familial variables were studied to determine their relationship to educational achievement and productivity: student sex, family size, ethnic group differences, parental level of education, parental involvement in education, student use of the library, and whether or not the student's family receives magazines and newspapers on a regular basis. Furthermore, certain variables were investigated at the level of the school building itself to determine school to school differences in educational productivity and achievement. Mathematics, reading, and science achievement at the fourth, eighth, and eleventh grade levels was analyzed in terms of each of these variables. The results described below were all found to be highly significant from a statistical perspective. The probability that the differences are attributable to chance is 1/100,000 or .00001.

Sex Differences

Analysis of IIEP achievement data in terms of sex showed statistically significant differences in mathematics performance at the eleventh grade level only. At the eleventh grade level, male students scored significantly higher in mathematics than did female students. There were significant sex differences in reading achievement at each grade level, with female students outperforming males. The most significant difference for reading was for the eleventh grade, with the achievement of females at 29.62, compared to 27.21 for males. Significant sex differences in science achievement were found at the eighth and eleventh grades. Male students performed better than did females. At the eleventh grade, males scored 33.41, as compared to 31.05 for female students.

Sex differences were also found to have a relationship to the Decade Study results. Females scored significantly higher than males on English Part I (16.3 for females versus 14.3 for males) and on English Part II (14.2 for females versus 12.1 for males). Sex differences were not found for mathematics, natural science, or social science. On the general skills subtest (composed of IIEP items) of the Decade Study, the range in performance for males is almost twice as large as the range for females. For male students, the standard deviation on the general skills test is 10.5, compared to a standard deviation of 5.9 for females.

Sex differences in achievement were also found during testing done to screen candidates for the Illinois Mathematics Talent Search. The most frequently used cutoff score for entrance into this advanced mathematics curriculum is 440 on a SAT type scale. Of those students scoring at least 440 in 1981, 65.6 percent were males and 34.4 percent were females. These results indicate an almost two to one participation rate of males as compared to females in education programs for the mathematically talented.

The results from Illinois students who took the ACT show statistically significant sex differences in each of the four subtests. Male students scored significantly higher (average of 19.0) than female students (average of 16.4) on the mathematics subtest. On the natural science subtest male students also performed significantly higher (average of 22.1) than female students (average of 19.6). The average performance of male students on the social studies subtest (18.4) was also significantly above the average of female students (16.8). Female students scored significantly above male students only on the ACT subtest of English. On the English subtest, female students averaged 18.3, whereas the average score of male students was 17.4.

Family Size

In terms of family size, significant differences were found at all grade levels for mathematics, reading, and science. The highest performance was found for students from two-child families at fourth and eighth grade for mathematics, at all grades for reading, and at fourth and eighth grade for science performance. This finding is consistent with that of the Zajonc model (1977), which indicates that in a two-child family, the interaction between the two children dramatically increases their achievement. That is, the two children operate in roles similar to that of teacher and student while experiencing daily life activities. At eleventh grade in mathematics and science, students who were from three-child families scored the highest. On all subtests, students from families with five or more children scored the lowest.

Ethnic Group Differences

Ethnic differences were also examined with 1981 IIEP data. Recent emphasis in the professional literature has been upon the "gains" made by black students, as compared to white students, in terms of their performance reported in 1982 by the National Assessment of Educational Progress. These recently reported findings have shown that the overall differences in scores of black versus white students have decreased over time (1970 through 1980). Similar analyses can be applied to the IIEP data. Table 5.1 presents the differences in black versus white student performance on the IIEP reading and mathematics items for 1979, 1980, and 1981. For mathematics achievement, a decline in black/white differences is noted at the eighth and eleventh grades. A plateau appears to have occurred at the fourth grade. For reading, a plateau is again found at the fourth-grade level, a decline in the difference at the eighth-grade level, and an increase in the difference at eleventh grade.

Table 5.1
Differences in Performance between
Black and White Students on the IIEP

Mathematics

Year	Fourth Grade	Eighth Grade	Eleventh Grade
1979	4.18	10.27	10.09
1980	4.55	8.16	8.81
1981	4.48	6.79	7.90

Reading

	Fourth Grade	Eighth Grade	Eleventh Grade
1979	7.63	8.16	15.81
1980	4.92	6.37	9.05
1981	4.92	6.18	9.63

Science

	Fourth Grade	Eighth Grade	Eleventh Grade
1977	2.96	6.10	4.77
1981	4.53	7.01	9.47

In terms of science achievement, black/white differences from 1977 to 1981 show a reverse trend. Scores of black versus white students at fourth and eleventh grades are almost twice as far apart in 1981 as compared to 1977. Thus, while the gap in student achievement on mathematics and reading is closing between black and white students, the gap is becoming wider for science achievement.

Ethnic differences were not found to be of statistical significance on any of the Decade Study subtests.

Recently released data from the College Board mirror this trend in mathematics and reading on the SAT. The mathematics scores of black students were 4 points closer to those of white students in 1981 as compared to 1976. Scores of black students on the verbal skills test were 7 points closer to scores of white students in 1981 than in 1976.

Parental Level of Education

IIEP achievement data were also analyzed in terms of parental level of education. In terms of father's education, significant differences were found at the eighth and eleventh grades for all curricular areas. Nine levels of father's education were assessed. Results show significantly better performance by students of parents with more education. For the eleventh grade level, there were differences of 3.45 points in mathematics, 3.73 points in reading, and 3.79 points in science between students of parents having only high school degrees as compared to students with parents having master's and doctoral degrees. Data in 1976 from the National Center for Educational Statistics indicate that roughly 35 percent of Illinois residents (18 years or older) finished their formal education with high school graduation and 14 percent completed four or more years of college.

The education of a student's mother demonstrates a similar significant impact on student achievement. However, the highest performance in mathematics, reading, and science (eleventh grade) are for students of mothers with college baccalaureate degrees, but lacking graduate degrees. This perplexing result could perhaps be related to less time spent with their children by mothers who have advanced degrees. In terms of science achievement at the fourth grade level, students with mothers who graduated, but did not continue their education after high school, had the highest achievement. Perhaps the quality and intensity of the time spent with a mother, rather than her level of education, contribute to higher student achievement. Given the number of items on the IIEP subtests, these point differences show an approximate 25 percent performance difference attributable to the education of the student's parents.

Parental Involvement in Education

Recent national research (1982) from the National Committee for Citizens in Education suggests a positive impact on student achievement of parental interest in education. The IIEP investigated this effect by asking students, "How often do you talk to your parents about your school work?" Students could respond from "never or hardly at all" to "just about every day." For mathematics achievement, significant differences of 8 percentage points at fourth grade, 3 percentage points at eighth grade, and 8 percentage points at eleventh grade were found. For reading achievement, significant differences of 10 percentage points at fourth grade, 7 percentage points at eighth grade, and 8 percentage points at eleventh grade were found. Thus, the involvement of parents in education facilitates a child's performance in school.

Student Use of Libraries and/or Bookmobiles

Student extracurricular activities have been noted by sociologists to facilitate performance in school. One variable of importance to extracurricular activities is student use of libraries and/or bookmobiles. Table 5.2 presents the mean scores of students in mathematics, reading, and science attributable to student use of the library. For mathematics, reading, and science, the highest achievement is found for students who use their libraries "once or twice a month."

Table 5.2
Differences in Achievement on the IIEP
Due to Student Use of Library or
Bookmobile Facilities

Mathematics

Frequency of Use	Fourth Grade	Eighth Grade	Eleventh Grade
Never or hardly at all	22.41	28.75	29.17
Once or twice a month	23.70	29.40	30.39
Once or twice a week	22.82	28.30	29.15
Just about every day	20.81	27.67	28.32
No public library	21.89	27.77	28.90

Reading

	Fourth Grade	Eighth Grade	Eleventh Grade
Never or hardly at all	17.58	22.04	27.56
Once or twice a month	19.13	22.87	29.91
Once or twice a week	18.22	21.68	28.73
Just about every day	16.90	20.54	27.24
No public library	17.63	21.60	27.23

Science

	Fourth Grade	Eighth Grade	Eleventh Grade
Never or hardly at all	15.69	24.73	31.69
Once or twice a month	16.73	24.86	33.13
Once or twice a week	16.06	23.49	32.10
Just about every day	14.95	23.10	30.46
No public library	16.30	24.06	32.29

Receipt of Magazines and Newspapers in the Home

Student performance on the IIEP was also studied in terms of whether or not magazines and newspapers were regularly received in the student's home. The regular receipt of magazines was significantly related to higher achievement in mathematics, reading, and science. There is a consistent increase in the impact of regular receipt of magazines in the home as one moves from fourth to eighth to eleventh grade, with the strongest impact being upon eleventh grade science achievement.

The regular receipt of newspapers, while statistically significant for all grades and the three subject-matter areas except fourth grade science, was not as strongly related to achievement as was the regular receipt of magazines. Perhaps the lessened effect of the regular receipt of newspapers versus magazines may be due to two factors. First, receipt of newspapers is quite common, with well over ninety percent of the students claiming that their families regularly received newspapers. Second, the material printed in newspapers may be less relevant or interesting to the students as compared to material in magazines. Asher (1978) and others have pointed to the consistent finding that interest in reading material correlates highly with performance on that material.

Size of School

The previous results have focused their attention on differences between individual students, that is, differences in student achievement based upon each student's sex, ethnicity, family size, etc. However, the achievement data can also be evaluated from the perspective of the school building which the students attend.

The importance of size of school as a variable related to student achievement has become increasingly recognized in recent years. IIEP achievement data relating to size of school are given in Table 5.3. It should be noted in Table 5.3 that there are approximately only 15 schools in Illinois which belong to the largest school category and have fourth grades. At the fourth grade level, students in smaller schools (less than 500 students) scored the highest in mathematics, reading, and science. At the eighth grade level, students from small schools scored the highest in reading and science and students from medium-sized schools (500 to 1,499 students) scored the highest in mathematics. At the eleventh grade level, students from medium-sized schools scored the highest in mathematics, reading and science.

The categories for the variable of school size were developed by Research Triangle Institute for the State Board of Education in 1975. These categories were small (below 500 students), medium (500 to 1,499 students), and large (1,500 or more students). This classification scheme may need to be revised as a reporting variable. It should be noted that other results relating school size to achievement can be found in a staff report on school organization presented to the Legislative Committee of the State Board of Education.

Table 5.3
Size of School Differences in Achievement
on the IIEP

Mathematics

Size of School	Fourth Grade	Eighth Grade	Eleventh Grade
Small (1-499)	22.66	27.42	29.26
Medium (500-1499)	22.26	29.86	30.59
Large (1500-)	19.10	21.90	28.38

Reading

	Fourth Grade	Eighth Grade	Eleventh Grade
Small (1-499)	18.26	22.67	28.38
Medium (500-1499)	17.56	21.51	29.55
Large (1500-)	12.00	15.15	26.93

Science

	Fourth Grade	Eighth Grade	Eleventh Grade
Small (1-499)	16.03	25.30	32.59
Medium (500-1499)	15.95	22.98	33.27
Large (1500-)	13.30	18.46	29.75

School to School Differences in Productivity

Each school could receive a score comprised of the overall average of the performance of the students within that school. The effects of the school itself on facilitating student performance can be directly established. Furthermore, an observation of all the school means could illustrate succinctly the diversity of school achievement, as well as a profile of the achievement in each particular subtest for the state as a whole. In 1981, school effects data for mathematics, reading, and science were analyzed. Mean performance in mathematics, reading, and science was calculated for each school participating in the fourth, eighth, and eleventh grade assessment. The means of all the schools within each grade were then averaged for each particular subtest to derive a state mean for fourth, eighth, and eleventh grade for mathematics, reading, and science. Individual school means were then compared against state means. These data, as well as graphs portraying the comparison of individual school means, were disseminated to the local districts in a series of statewide conferences held in 1981. Table 5.4 presents statewide means and standard deviations for 1981 in mathematics, reading, and science.

Table 5.4
1981 Statewide Performance in Mathematics, Reading, and Science

Mathematics

Statistic	Fourth Grade	Eighth Grade	Eleventh Grade
Mean	22.5	28.7	29.3
Standard Deviation	2.8	3.8	3.3

Reading

	Fourth Grade	Eighth Grade	Eleventh Grade
Mean	18.0	22.1	28.2
Standard Deviation	2.7	2.9	4.3

Science

	Fourth Grade	Eighth Grade	Eleventh Grade
Mean	15.9	24.3	31.9
Standard Deviation	2.5	3.5	4.1

As can be seen from Table 5.4, there were increases in the school means from fourth to eighth to eleventh grades. However, perhaps the most important information in Table 5.4 is in the rows labeled "standard deviation." The standard deviation indicates the overall diversity in performance for each particular grade and subtest. These data indicate an increasing diversity between schools in terms of achievement as one compares fourth to eighth to eleventh grade. This result holds for each curriculum area. Thus, there is much more homogeneity in performance (for mathematics, reading, and science) of Illinois schools educating fourth grade students than for Illinois schools educating eleventh grade students. In fact, diversity among the eleventh grade schools in reading and science performance is almost twice that of the fourth grade schools.

The diversity among the schools as well as their comparison to the state mean can also be depicted graphically. This graphic portrayal is given in Figures 5.1 through 5.9. Each of these figures profiles the means of the schools participating at that grade level (fourth, eighth, or eleventh) for a particular subtest (mathematics, reading, or science). An "m" denotes the position of the school mean on the mathematics figures, an "r" denotes the position of a school mean on the reading figures, and an "s" denotes the school mean on the science figures. The solid line across each figure represents the statewide mean for comparison against the performance of each school for that subtest. These graphs were also disseminated to local districts during the 1981 statewide conferences.

Average Performance in Mathematics by School
Grade 4

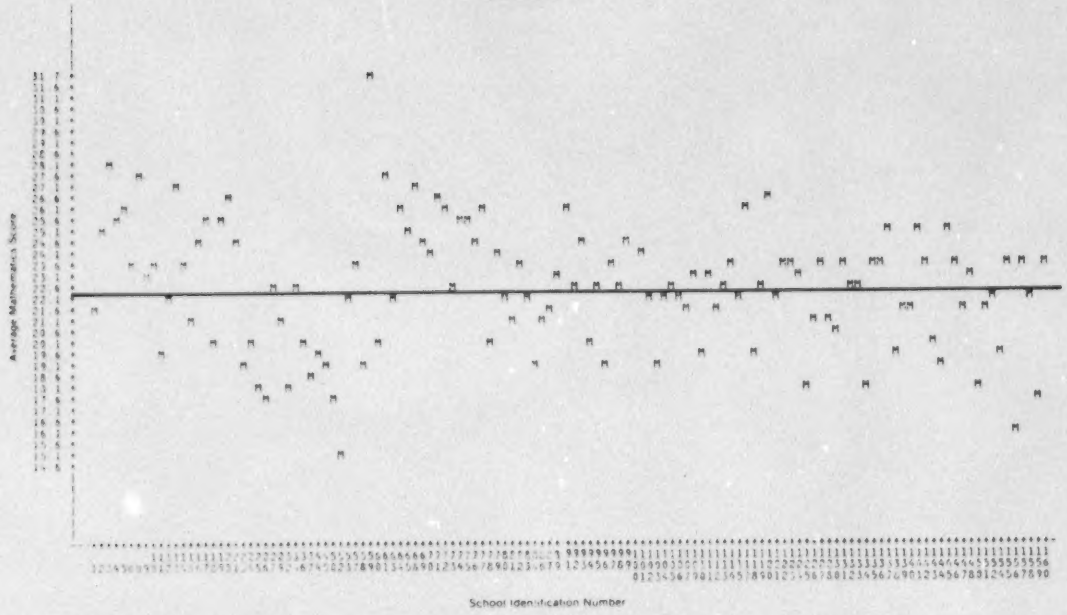


Figure 5.1.
Grade four average performance in mathematics by school.

Average Performance in Mathematics by School
Grade 8

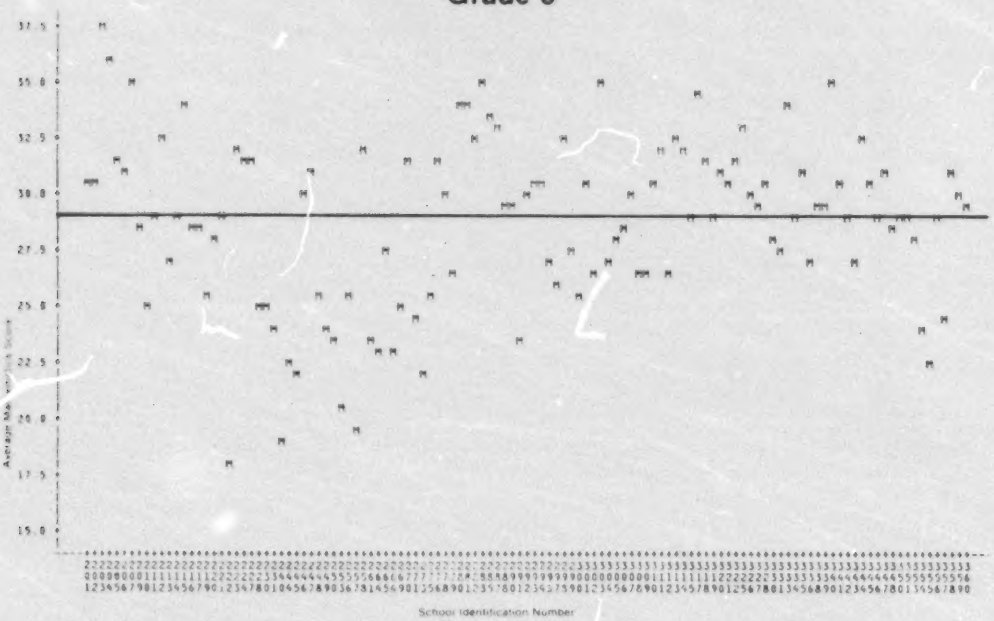


Figure 5.2.
Grade eight average performance in mathematics by school.

Average Performance in Mathematics by School
Grade 11

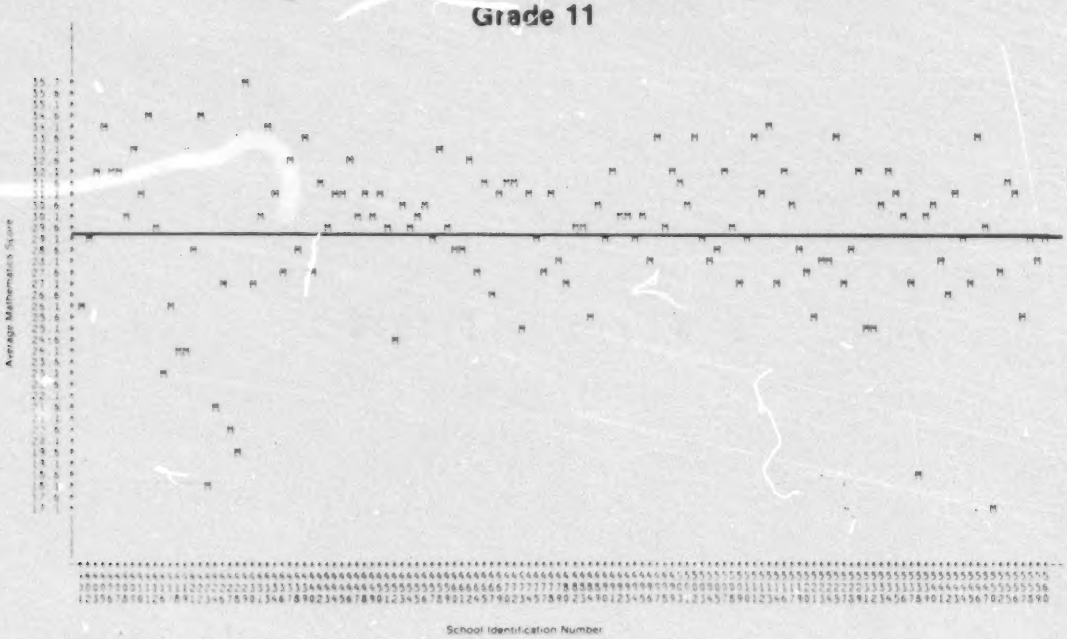


Figure 5.3.
Grade eleven average performance in mathematics by school.

Average Performance in Reading by School
Grade 4

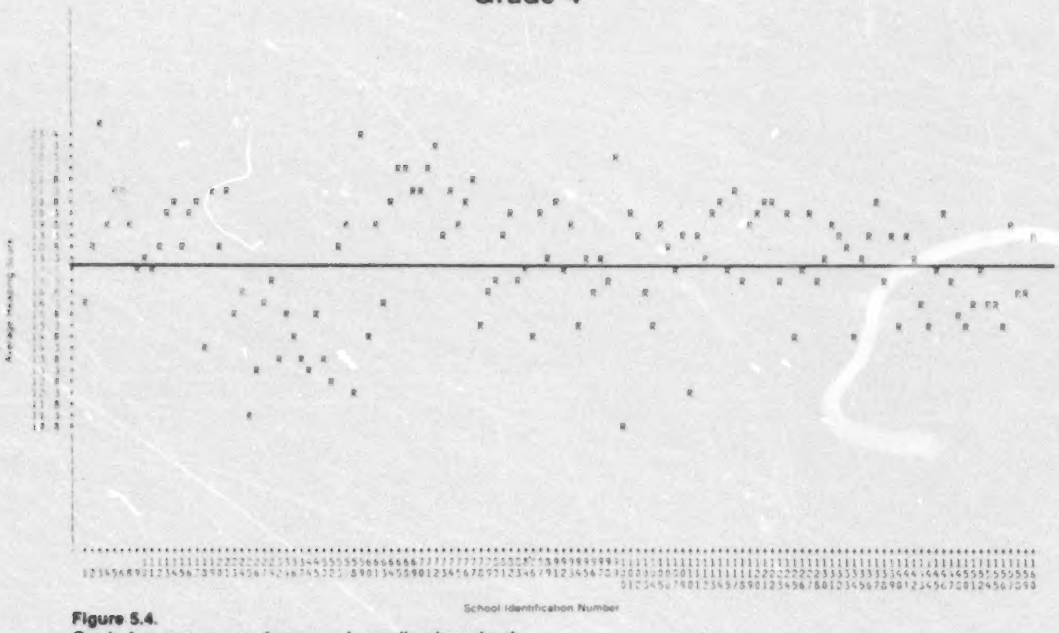


Figure 5.4.
Grade four average performance in reading by school.

Average Performance in Reading by School
Grade 8

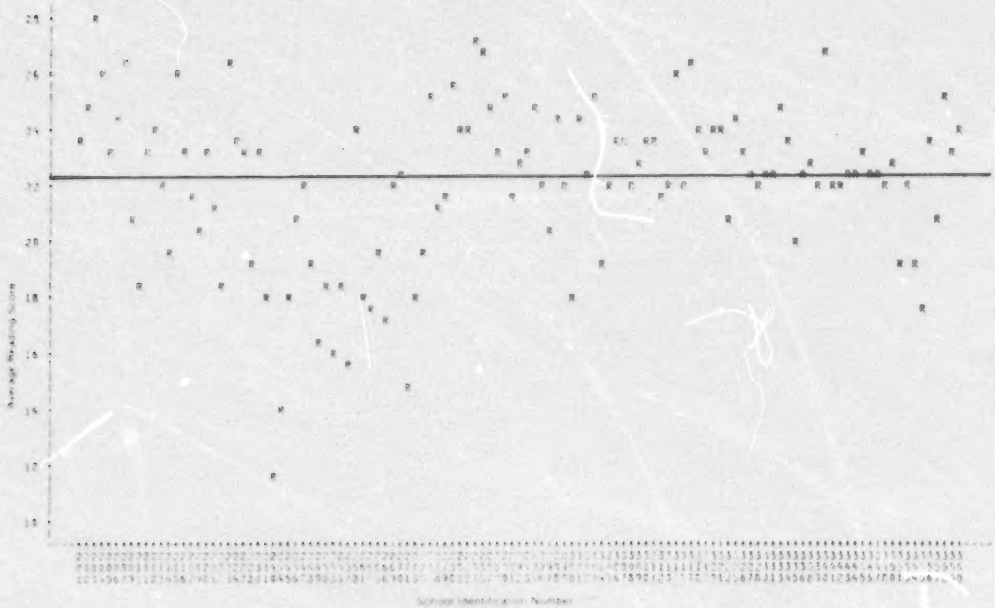


Figure 5.5.
Grade eight average performance in reading by school.

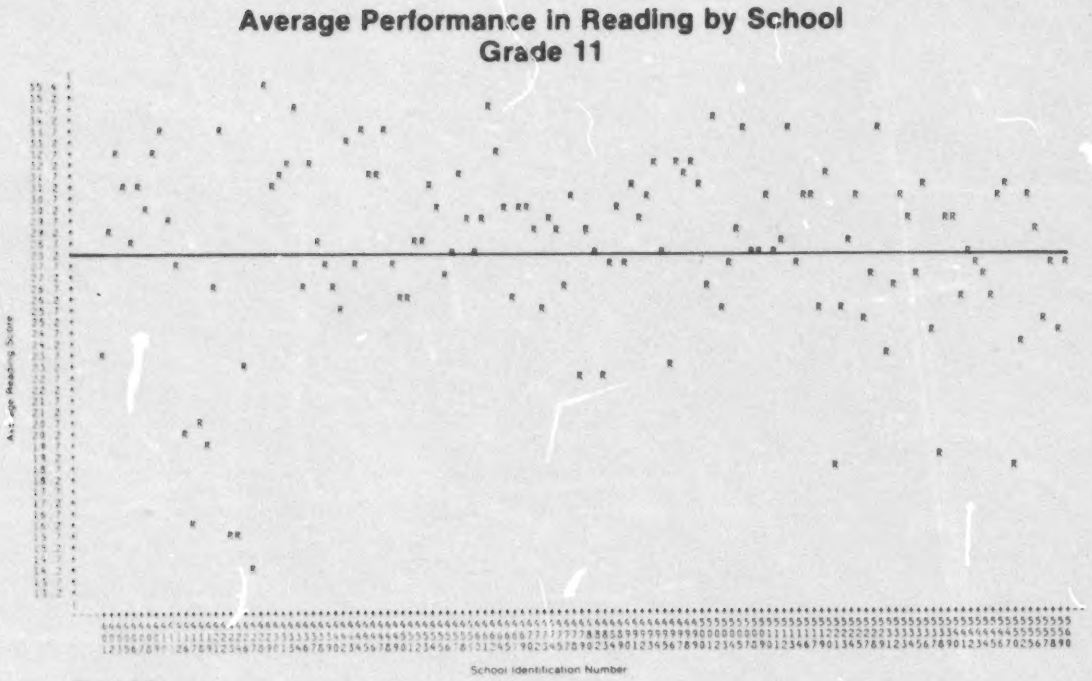


Figure 5.6.
Grade eleven average performance in reading by school.

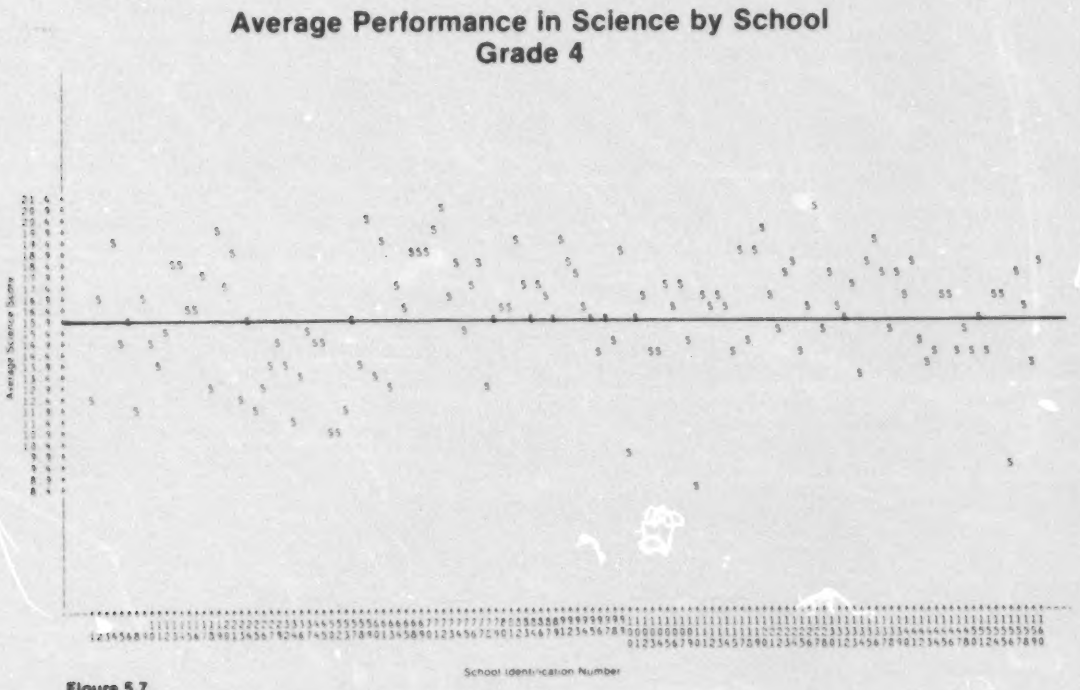


Figure 5.7.
Grade four average performance in science by school.

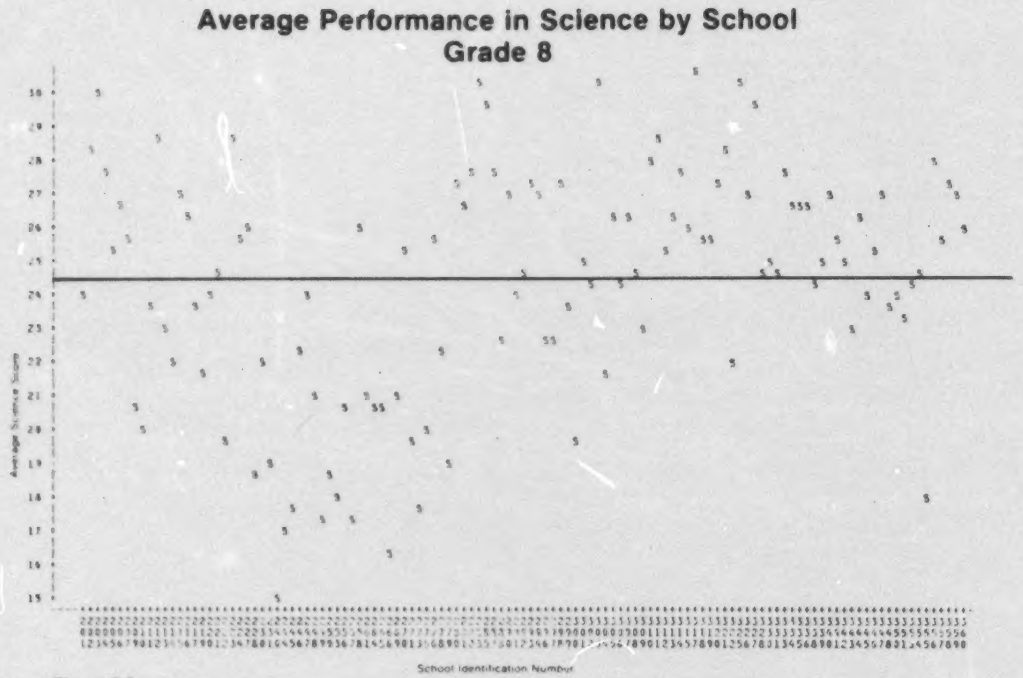


Figure 5.8.
Grade eight average performance in science by school.

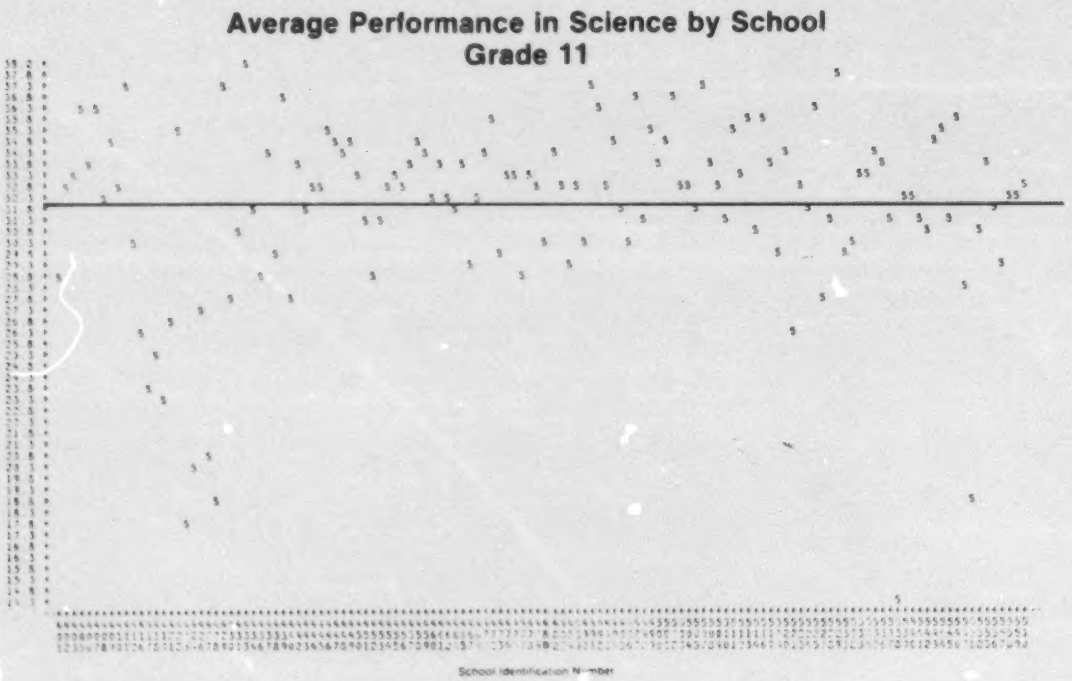


Figure 5.9.
Grade eleven average performance in science by school.

Motivation and Achievement

Motivational factors can facilitate or inhibit student performance. IIEP staff have studied several motivational factors in connection with student achievement including test anxiety, achievement expectation, minimal standards, perceived value of achievement, continuing motivation, sense of competency, and attribution. Each of these motives has been found to have a decisive impact upon achievement of a student.

Three of the most critical factors are the student's expectation, minimal standard, and perceived value of achievement. A student's expectation of achievement is defined as the number of items that a student expects to get correct upon the mathematics subtest of the IIEP. A student's minimal standard is the lowest performance on the IIEP mathematics subtest which that student would obtain and still be satisfied with the results. A student's perceived value of achievement is the overall value of academic achievement to the student when measured on a seven-point scale.

Results demonstrate that a student's expectation clearly influences the student's actual achievement and productivity levels. This relationship between expectation and achievement was found in all fourth, eighth and eleventh grade schools and was unaltered by contextual, social, or cultural differences. However, there was a significant school effect operating upon a student's minimal standard and perceived value of achievement. The environment of a school, its teachers, staff, principal, and peers, all influence student standards and values for achievement. The extent of the effect varies from school to school, indicating that some schools may exert a stronger press to achieve than other schools. The data substantiating these effects are displayed in Table 5.5.

Table 5.5 reports the coefficients of variation for expectancy of success, minimal standard for achievement, and attainment value for achievement at each grade level. Essentially, these coefficients mirror the overall diversity and disparity of scores related to particular variables. As the coefficient tends toward whole numbers, much more diversity is prevalent. As can be seen from Table 5.5, expectancy of success has the lowest coefficient for each grade level. Furthermore, it appears that the preeminent impact of the school environment upon a student's minimal standard for achievement occurs at the eighth grade, whereas the most impact upon the student's value for achievement is at the fourth grade level. Thus, a student's value and standard for academic achievement are dependent upon the school context, whereas the expectancy of success is idiosyncratic to each student.

Table 5.5
Coefficients of Variation* for Within School Results
of Correlations between Expectancy, Minimal Standard,
Attainment Value and Performance

	Fourth Grade	Eighth Grade	Eleventh Grade
Expectancy of Success	1.03	0.65	0.40
Minimal Standard for Achievement	4.57	7.25	1.45
Attainment Value for Achievement	29.00	1.92	1.67

*Indicating that portion of the mean occupied by the standard deviation of the distribution. The larger the coefficient, the more the variation, school to school.

The influence of test anxiety on inhibiting a student's test performance was studied using IIEP data. The IIEP data show statistically significant score point differences in mathematics between test-anxious and test-comfortable students of 2.65 points at fourth grade, 3.19 points at eighth grade, and 4.42 points at eleventh grade. Reading scores show statistically significant differences of 2.16 score points at fourth grade, 2.22 score points at eighth grade, and 3.58 score points at eleventh grade. Science performance showed score differences between test-anxious and test-comfortable students of 1.52 at fourth grade, 2.40 at eighth grade, and 4.2 at eleventh grade. In terms of background variables, sex differences were found only at eleventh grade with females significantly more test-anxious. Family size did not have any significant relationship to test-anxiety. However, size of school did, with students being less test-anxious in larger schools. The latter finding may be due to a less personal press to do well on each test due to the greater anonymity of being in a larger school. Parental education was related to test comfort, with students of parents with more education having significantly less test comfort.

While results relating to test anxiety are interesting, perhaps even more interesting is the contribution of the IIEP to national efforts to measure and decrease text anxiety. Due to the developmental work of the IIEP staff, a seven-item test anxiety scale, known as the Illinois Test Comfort Scale was constructed. This test anxiety scale has received nationwide attention since it is now being used in the national High School and Beyond Study, in national Title I evaluation efforts, and by the College Board. Information concerning the scale and copies of the scale itself have been requested by school district personnel from throughout Illinois and the rest of the United States. While the scale appears simple in design and structure, it possesses power needed to detect items from tests which provoke undue levels of anxiety on the part of students. Those items can then be eliminated. The Illinois Test Comfort Scale is as follows.

The Illinois Test Comfort Scale

1. Do you feel relaxed when the teacher says he/she is going to ask you questions to find out how much you know?

   a. Yes
   b. No

2. Do you like tests in school?

   a. Yes
   b. No

3. Do you feel relaxed before you take a test?

   a. Yes
   b. No

4. Do you feel relaxed while you are taking a test?

   a. Yes
   b. No

5. When the teacher says that he/she is going to give the class a test, do you usually feel that you will do good work?

   a. Yes
   b. No

6. When the teacher says that he/she is going to give the class a test, do you feel relaxed and comfortable?

   a. Yes
   b. No

7. While you are taking a test, do you usually think you are doing good work?

   a. Yes
   b. No

One of the major outcomes of schooling is not just the buildup of facts and knowledge, but the inculcation of interest in education and learning which lasts much longer than the mere time in the classroom. That is, it is the development of intrinsic interest, a thirst for knowledge, or continuing motivation to learn and achieve. Continuing motivation can be likened to a student's wish for extra work on a particular area of interest, or the demonstration at home, such as in the kitchen, of all the processes learned d[illegible] hemistry class. This motive was measured on the IIEP. Students wer[illegible]en fifteen optional mathematics items. The number of those additional items which were attempted by each student was determined. The results indicate that students with a continuing motivation to achieve attempted significantly more items than other students. Furthermore, student continuing motivation was not related to the student's ethnicity, size of family, and regular receipt of magazines and/or newspapers. A sex

difference was found at the fourth and eighth grade levels, with female students demonstrating more motivation than male students. A student's continuing motivation was also found to be significantly related, at all grade levels, to the size of school the student attended. At the eighth and eleventh grade levels, students from medium-sized schools exhibited more motivation than students from smaller or larger schools. At fourth grade, students from smaller schools exhibited significantly more motivation than students from medium- or large-sized schools. Students from smaller schools attempted 4.84 more items than students from larger schools.

A widespread belief held by educators such as Shavelson, Peirs, Bandura, and Coopersmith is that a student's sense of self-competence and efficacy relates to that student's capacity to achieve. To measure a student's sense of competency, each student was asked to indicate whether he/she felt less capable, as capable, or more capable than other students in the classroom. At each grade level, significant differences in mathematics, reading, and science performance were found for students with high, medium, or low levels of sense of competence. Score point differences between the high and low levels of sense of competence were 5.32, 5.94, and 7.05 in mathematics for the fourth, eighth, and eleventh grades, respectively. For reading, significant differences of 7.06, 7.48, and 11.93 points were observed. For science, score differences were 4.48, 4.68, and 7.59.

Related to the motive of sense of competence is the student's rationale or belief of the cause of their successful school behavior. Thus, students could attribute their successful academic performance to diverse causes. Past research has indicated that students attribute their successful school performance primarily to one of four causes: student ability, student effort, ease of the school task or test, or student good luck. Results on the IIEP indicate that students attributing their performance to their own ability and effort performed significantly higher than students attributing their performance to task characteristics or good luck. In fact, students attributing success to their own ability scored higher in mathematics, reading, and science than any other students tested. Students attributing their performance to their own effort scored below students attributing performance to their ability. Table 5.6 presents the percentages of Illinois fourth, eighth, and eleventh grade students ascribing their success to their ability, effort, task characteristics, and good luck.

Table 5.6
1981 Percentage of Students Attributing
Successful Academic Performance
to Each Factor

Factor	Fourth Grade	Eighth Grade	Eleventh Grade
Student ability	19.4	15.3	14.4
Student effort	60.4	69.6	67.1
Task ease	11.6	8.7	10.7
Good luck	6.4	6.0	7.2

Discovery of the prevalent relationships of these motivational factors supports the need for other avenues and strategies with which to increase a student's productivity and achievement by decreasing the effects of inhibiting variables, such as anxiety, and increasing the effects of facilitative factors, such as expectation of success and value for achievement.

APPENDIX

The Student Achievement and Progress Report is based on results from several testing instruments, including the (1) Illinois Inventory of Educational Progress (IIEP); (2) Decade Study test; (3) High School and Beyond test; (4) Scholastic Aptitude Test (SAT); and (5) American College Test (ACT). The following information concerning number of items per test is provided so the reader will know the range of possible scores on each instrument and can make meaningful inferences concerning scores presented in the report.

Illinois Inventory of Educational Progress (IIEP)--1981

Mathematics Tests	
Fourth Grade	39 items
Eighth Grade	42 items
Eleventh Grade	40 items
Reading Tests	
Fourth Grade	31 items
Eighth Grade	38 items
Eleventh Grade	47 items
Science Tests	
Fourth Grade	31 items
Eighth Grade	41 items
Eleventh Grade	48 items

Decade Study Test

Natural Science Subtest	23 items
Social Studies Subtest	30 items
English Part I Subtest	35 items
English Part II Subtest	30 items
Mathematics Part I Subtest	36 items
Mathematics Part II Subtest	24 items
General Skills Subtest	10 items

High School and Beyond Tests
Sophomore Test (1,670 Illinois students tested in 1980)

Vocabulary Subtest	21 items
Reading Subtest	20 items
Mathematics I Subtest	28 items
Mathematics II Subtest	10 items
Science Subtest	20 items
Writing Subtest	17 items
Civics Subtest	10 items

Senior Test (1,435 Illinois students tested in 1980)

Vocabulary I Subtest	15 items
Vocabulary II Subtest	12 items
Reading Subtest	20 items
Mathematics I Subtest	25 items
Mathematics II Subtest	8 items

Scholastic Aptitude Test (SAT)

Verbal Subtest	200-800 score range
Quantitative Subtest	200-800 score range

American College Test (ACT)

English Subtest	1-36 score range
Mathematics Subtest	1-36 score range
Social Studies Subtest	1-36 score range
Natural Science Subtest	1-36 score range
Composite Scale	1-36 score range

A second aid for interpreting performance data contained in the report is knowledge of the difficulty of the various testing instruments. Regardless of the content matter tested (e.g., mathematics), students would be expected to score less well on a more difficult test than on an easier test in the same content area. Table A.1 presents the statistical levels of difficulty for each of the tests. The difficulty scale ranges from -3 to +3, with zero as the mean.

Table A.1
Item Scaling Analyses

Test		Standard Deviation
High School and Beyond Sophomore Test		
Average Difficulty	.19	1.12
Average Discrimination	.76	.28
Average Pseudo-Chance	.15	---
High School and Beyond Senior Test		
Average Difficulty	.23	1.26
Average Discrimination	.83	.31
Average Pseudo-Chance	.17	---
Illinois Inventory of Educational Progess		
Average Difficulty	.18	1.10
Average Discrimination	.98	.31
Average Pseudo-Chance	.16	---

Decade Study Subtests--Average Difficulty	
Mathematics Part I	2.00
Mathematics Part II	1.51
Social Science	1.36
Natural Science	1.35
English Part I	1.18
English Part II	.85

The data in Table A.1 indicate similar levels of difficulty for the IIEP and High School and Beyond tests. Both instruments contain items on which approximately 50 percent of the students should perform correctly. Likewise, the discrimination levels of the IIEP and High School and Beyond items are similar. This similarity in difficulty and discrimination levels indicates that the two tests are essentially equated. In contrast to these instruments, the Decade Study subtests range in difficulty from four to almost ten times as difficult as the subtests on the IIEP and High School and Beyond tests. The Scholastic Aptitude Test and the American College Test are even more difficult than the Decade Study subtests. These college entrance examinations are designed to obtain correct performances by only the select group of students who are seeking acceptance into colleges and universities.

The Decade Study test included a subtest composed entirely of IIEP items used to help anchor the performance of students on the Decade Study test to performance on the IIEP. Student performance on the IIEP subtest of the Decade Study test was not significantly different than performance on the regular IIEP test. The similarity in performance helps confirm the difficulty level of other Decade Study items as well as the generalizability and representativeness of the Decade Study results.

A third aid in interpreting the results of this report relates to the significance of the findings. The term significance can be described from two perspectives: statistical significance and educational significance. The definition of statistical significance reflects the very essence of the credibility one places in the results from research and testing. Thus, stating that a finding is statistically significant means that one has credibility and belief that the result did not occur by chance or some other unknown factor. In this report, the term "statistical significance" will be employed whenever there is less than one chance in a hundred (.01) that the results reported are due to chance. Thus, the reader can be 99 percent sure that the results presented are an accurate representation of the achievement of Illinois students and the productivity of Illinois schools.

The term "educational significance" will be used for those results which account for strong effects upon schooling and achievement. For example, if one factor (e.g., parent education) causes a 10 percentage point or more difference in another factor (e.g., achievement), then that first factor would be defined to be educationally significant. Occasionally, a result will be both statistically significant and educationally significant.

Finding that a factor does not have a statistically significant impact upon schooling or achievement is an important finding in and of itself. That is, if one wished to establish a list of factors which account for achievement (so that intervention can occur to facilitate that achievement), one would want to know which factors to leave out of that list so that time and expense would not be expanded intervening upon factors with little utility. Thus, by way of example, if the size of a school's library was not found to be significantly related to student achievement, it is important to report its non-significance, since from the publication of that non-significance, there should be no attribution to "size of library" as a cause of achievement.

Further technical information concerning the IIEP test is as follows. Items are selected for inclusion in the IIEP by content specialists. These items are then pilot-tested with large samples of fourth, eighth, and eleventh grade students. Items which meet certain scaling criteria are selected.

The criteria are that items: (1) be factorable; (2) have a difficulty level geared for the moderate student; (3) have exceptionally high discrimination capacity (correlation with their subtest); (4) be unbiased as to ethnic or sex group responses; and (5) have minimal chance of being guessed correct. This sophisticated scaling equates the grade levels of any particular year. Comparisons between years are made on the basis of trend items, which are anchored such that their difficulty, discrimination, and pseudo-chance guessing levels are equated to the performance in 1976, the year they were first administered.

The IIEP is designed according to strategies and rules of construct validity. The reliability of the IIEP is approximately .97. The average concurrent validity of the subtests has been established to be .81. The sampling of the participating schools and students follows a random sampling model. All fourth, eighth, and eleventh grade students in Illinois have an equal chance of being tested on the IIEP. The size of the sample is large enough to guarantee that the results of the IIEP are generalizable across the state. The error rate around any percentage estimated by the IIEP is between plus or minus 1 1/2 percent.

The test materials used in the Decade Study were originally constructed by the Educational Testing Service in 1967-68 as a college entrance screening instrument for Florida students. Portions of that test were obtained for use by the Illinois Statewide Testing Program at the University of Illinois in 1970. The resulting instrument contained two subtests each on mathematics and English, and one subtest each on social studies and natural science. In conducting the Decade Study, the State Board of Education added an additional subtest of general skills items from the IIEP.

It should be noted that the contextual results were obtained through multivariate analyses. The multivariate analyses control for the effects of all other context variables when the results are reviewed for each particular context variable. For example, the effect of parent education is controlled for when the results for family size are analyzed. Thus, a clearer picture can be obtained of the relative importance of each context variable.

In a review of the performance of the Decade Study test items in the subtests for different administrations of the test, it was found that the test performed in a very consistent manner. Subtest correlations of the 1981 Illinois performance with 1968 Florida data ranged from .74 to .97 (Social Studies = .91; Mathematics Part I = .95; Mathematics Part II = .95; English Part I = .94; English Part II = .97; and Natural Science = .74).

A study conducted at the University of Illinois in 1972 used a random sample of the 1971 administration of the test. The correlation for English Part I with the 1981 Illinois results was .97, and the correlation for Mathematics Part II with the 1981 Illinois results were .96. These results indicate that the performance on the test is very similar at different times, for different states, and for different grade levels (seniors versus juniors).

On the other hand, the internal consistency of the subtests on the 1981 Illinois administration of the Decade Study test was slightly lower than is usually obtained in professionally developed testing. Reliabilities ranged from .63 to .81 with Kuder Richardson formula 20 and 21 (KR 20 and KR 21):

Subtest	KR 20	KR 21
Social Studies	.75	.72
English Part I	.78	.73
English Part II	.80	.76
Mathematics Part I	.81	.80
Mathematics Part II	.71	.68
Natural Science	.66	.63
General Skills	.72	.66

Reliabilities are undoubtedly low on the general skills materials because the general skills instrument contains only 10 items, and reliabilities generally improve with length. For the other subtests, the number of students operating at a near-chance level could be a contributing factor.

Further technical information concerning the High School and Beyond tests can be obtained in publications from the National Opinion Research Center in Chicago. Information on the ACT subtests can be obtained from publications from the American College Testing Program, Iowa City, Iowa. Further technical information on the Scholastic Aptitude Test can be obtained from the College Board, Princeton, New Jersey.

"END OF DOCUMENT"